"AIRPLANES, COMBAT AND MAINTENANCE CREWS, AND AIR BASES"

The World War II and Early Cold War Architectural Legacy of Holloman Air Force Base (ca. 1942-1962)

by
Martyn D. Tagg

Contributions by
Sonya Cooper
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Air Combat Command
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DEDICATION

This report is dedicated to my father, Chaplain Lt. Col. Lawrence V. Tagg, USAF (Retired). He gave me the opportunity to grow up on Air Force bases and see battlefields throughout Europe and shared his understanding and intense interest in military history. My father spent his career with the Air Force living many of the experiences written about in this publication. It's his influence on me which made this production an enjoyable experience.

To this day I carry with me a reminder of my experience growing up as a military dependent during the Cold War. It is an official dependent dog tag issued in 1963 at Wiesbaden AFB, Germany, as part of the USAF's plan to evacuate women and children in the event of a Russian or East German invasion of West Germany.

Title: From a speech by General Henry "Hap" Arnold to a congressional committee in January 1939 (Futrell 1955:119).

Cover art: A World War II Field Maintenance Hangar: architectural drawing of Building 1079 (CE File 1079).

"The historic buildings that we have on our facilities reflect the history of our country and the Air Force. They represent the men and women that have served and given their lives for freedom. In an age of change, it is important that we preserve our historic buildings and districts, while maintaining their usefulness to fulfill our mission in the 21st century."

Sheila E. Widnall
Secretary of the Air Force
17 April 1995
(Wagner 1996: back cover)

PREFACE

Martyn D. Tagg
Headquarters Air Force Materiel Command Cultural Resource Manager
(Holloman AFB Archaeologist, 1992-1998)

The cultural resources program on Holloman Air Force Base (HAFB) was established in 1992 with a focus on proactive, rather than reactive, management of the resources. Although the majority of early work involved cultural resources inventory of HAFB-administered land, an effort was also made to compile a comprehensive history of this land and the base through a series of research projects. These research projects, and thus the proactive cultural resources program, were made possible largely due to the Department of Defense (DoD) Legacy Resource Management Program (LRMP).

The DoD is the steward for about 25 million acres of land in the United States and is responsible for the management and protection of a wide variety and large number of irreplaceable natural and cultural resources. Established by the 1991 Defense Appropriations Act (Public Law 101-511, Section 8120), the LRMP fulfills the Congressional mandate to "determine how to better integrate the conservation of [these] . . . resources with the dynamic requirements of military missions" (DoD 1991, 1992; U.S. Air Force [USAF] 1994).

The purpose of the LRMP is to "promote, manage, research, conserve, and restore the priceless biological, geophysical, and historical resources which exist on public lands, facilities, or property held by the DoD." The functions of the LRMP are divided into Program Development tasks for biological, cultural, and geophysical resources. These are further divided into Specific Task Areas for project management, survey of current programs, data management, decision frameworks, earth resources, biological resources, cultural resources, the Cold War, education, public awareness and recreation, Native American and settler communities, and stewardship education and training (DoD 1992; USAF 1992). Demonstration projects have been conducted at more than 90 DoD installations throughout the continental United States (CONUS) and overseas.

HAFB, an Air Combat Command (ACC) base of over 59,000 acres in southern New Mexico, is one of the installations conducting LRMP projects. Prior to Fiscal Year (FY) 93, only 3.5 percent of this acreage had been inventoried for cultural resources and four archaeological sites documented. Because of the limited nature of the archaeological work and the small size of most surveys, little was known about the cultural resources on base-administered properties. The LRMP became a method to advance this knowledge, providing the means to complete projects not eligible for compliance-driven funds. In FY93, HAFB became involved in the LRMP with funding for three cultural resources projects. These projects were identified as "milestones and priorities for National Register Surveys" in the HAFB Historic Preservation Plan (HPP) and included an historic architectural assessment; thematic survey of early missile, instrumentation, and test object sites; and a thematic survey of historic ranches and ranch sites (Eidenbach 1994:50). The projects fulfilled the FY93 LRMP Topical Theme of "World War (WW) II and Cold War research topics and stewardship projects, and development of other contemporary history themes which contribute to stewardship" (USAF 1992).

As one means to facilitate the completion of the LRMP projects, an Interagency Agreement (IA) was created between HAFB and the New Mexico State Historic Preservation Division (HPD). This cooperative agreement allowed the HPD to become more actively involved in the Legacy program, and it gave HAFB access to qualified archaeologists, historians, historic architects, and certified staff. The HPD managed the logistical aspects of the projects and issued grants to organizations and individuals with the experience to provide the best possible final products. The HAFB archaeologist was the technical manager, ensuring the results would provide the information necessary for managing resources on HAFB, complement the base mission, and meet the LRMP guidelines.

The Historic Architectural Assessment (DoD Legacy No. 9300786) was funded under the LRMP Task Area of the Cold War, with the objective to "inventory, protect, and conserve the physical and literary property and relics of the Department of Defense connected with the origins and development of the Cold War" (USAF 1992). It was designed as a demonstration project to begin the identification and documentation of historic buildings and structures on HAFB-administered lands. This architectural project focused on properties constructed during WW II, as well as a number of unique facilities associated with early Cold War missile development. The project resulted in the upgrading of the previously developed HAFB facility inventory form, an inventory of historic blueprints on file in the HAFB Civil Engineer drawing vault, and the field inspection and documentation of 34 buildings and structures.

HAFB played an important role as a training base for Heavy and Very Heavy bomber crews in WW II and was a development facility for missile and rocket research during the early Cold War. The identification and documentation of facilities associated with these events have provided valuable insight on the early military use of Alamogordo Army Air Field and HAFB, as well as initiating steps to document, protect, and preserve this legacy of the USAF. The Historic Architectural Assessment project has also continued the process of providing initial evaluations of all facilities on the base constructed during WW II and the Cold War. This is extremely important because few of the original WW II and early Cold War era buildings still exist, and of those that do, only a small number retain their historic integrity. This architectural assessment can also be used to promote and modify the demonstration project so that the methods can be used successfully on other DoD installations.

DoD Legacy Project 9300786 was originally conducted in 1994 through the IA with the HPD, which is discussed above. Unfortunately, the final report by Human Systems Research (HSR), *Reach For the Sky* (Eidenbach and Wessel 1995), did not fulfill the requirements set forth under the HAFB project scope (Tagg 1995a). The State Historic Preservation Officer (SHPO) reviewed the deliverables and stated that the report was incomplete and the inventory forms did not meet the Secretary of Interior's Standards for historical documentation or identification of historic resources (Taylor 1995). For these reasons, the project was completed with assistance by Geo-Marine, Inc. (GMI), through a contract with the U.S. Army Corps of Engineers (COE). GMI personnel and subcontractors conducted the architectural assessments, completed the building forms, and provided administrative support, and the HAFB archaeologist wrote most of the report. The report presented here represents the final document for LRMP Project 9300786.

This report is the sixth in the HAFB Cultural Resources Publication series, which was created to showcase the wide variety of projects made possible by the LRMP on HAFB (see back cover). The publication series will ensure quality reporting of LRMP and other types of research projects conducted on HAFB and allow the data to be distributed to local professionals and other DoD cultural resources managers. The publications have also begun to illustrate the results of the initial goal set forth in 1992 of compiling a comprehensive base cultural overview. The first and fourth reports, *I Never Left A Place That I Didn't Clean Up* (Hawthorne 1994) and *A Life Like No Other* (Hawthorne-Tagg 1997), discuss the pre-military historic use of current HAFB-administered lands from early European settlement of the area until the establishment of the base. The second and fifth in the report series, *"We Develop Missiles, Not Air!"* (Mattson and Tagg 1995) and *Guided Missile Testing in New Mexico* (Weitze 1997), illustrate HAFB's role as an early missile, rocket, instrumentation, and aeromedical research development facility in the early Cold War. The third report, *"Full Moral and Material Strength"* (Fulton and Cooper 1996), documents the first architectural assessments conducted on HAFB, addressing Cold War facilities constructed between 1950 and 1960, and presents a building inventory form developed specifically for HAFB.

The results of the current architectural assessment, as well as the other projects conducted on HAFB, are useful far beyond the boundaries of this base. It is hoped that these projects will encourage other bases to begin the process of documenting and reporting on the many unique architectural and archaeological resources located on DoD installations, thus providing a better understanding of the USAF during these important periods of U.S. history.

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ACKNOWLEDGMENTS

A number of challenges were presented during the completion of this report. First, it is always difficult to take an incomplete project and complete it. On the other hand, I've always believed in the adage "if you want something done right, do it yourself." Second, it is difficult to write about a subject such as military architecture and make it both interesting to the reader and worthwhile to the professional researchers. To accomplish this, it is always a good idea to surround oneself with individuals who can accomplish the tasks involved. A number of such people contributed to this report, and I appreciate their assistance and input. If anyone is inadvertently left out, I offer my apologies.

Sonya Cooper and Jean Fulton, who conducted previous architectural assessments on the base and published a report in the HAFB Cultural Resources series, completed the facility assessments and field forms. Their previous work speaks for itself and, once again, they did a great job providing the data that is the focus of this report. They also took most of the facility photographs reproduced here. I can't thank them enough for their hard work, professionalism, and patience with my editorial comments. Sonya wrote a portion of the discussion on construction methods, which adds a dimension to the report I could not have completed. Eugene Kilmer, of Mag Drafting (Albuquerque, New Mexico), provided the excellent computer generated (AutoCAD) floor plans for the field forms and the report.

Many individuals from HAFB assisted in one way or another. Diana Moya, Real Property officer, was always available to help me understand the world of Real Property. She interpreted Real Property Accountable forms and building acronyms and provided a wealth of information on the facilities that was not found on any of the forms. Maria Belandres (Realty Clerk) and Aurora Arrieta (Realty Specialist) also filled in many gaps regarding Real Property issues. Senior Airman (SRA) Samuel (Sam) Luke, HAFB Drafting Office, produced the base location maps in Appendix C. Sam, Staff Sgt. Cassamo Remtula, Master Sgt. Dennis Lamm, and Airman First Class (A1C) Shannon Russell also assisted with accessing, locating, and copying numerous engineer drawings and blueprints from the Civil Engineer drawing vault. Dennis Belknap from the High Speed Test Track and Marvin Bunker and Mr. Sandoval, from Land-Air Division of Dynalectron Corporation, provided information, photographs, and documents on a number of the buildings. SRA Wear, SRA Sharon Baltazar, and A1C Colette Horton from the HAFB photo lab copied photos from books, made copies of historic photos, and took some of the fine photographs provided within. Bill Ford (Environmental Flight) provided information on recent uses of Building 1442 (Able 51) that were not documented in Real Property records. Finally, as always, John Poland (Environmental Flight Chief) and Fred Fisher (Natural/Cultural Element Chief) gave me the support and latitude needed to write this report and still complete my everyday management duties.

Personnel from Geo-Marine, Inc. (El Paso Office) compiled and produced the final report. Regan Giese (Regional Manager) and Duane Peter (Vice President/Plano Office) reviewed the document and provided valuable input. Duane, with assistance from Joe Freeman, also provided information on hollow clay tile construction. Other production tasks were completed by: Sharlene Allday (draft editing), Tina Powell (draft editing and formatting), Melinda Landreth (map reconstruction), Carolyn Barnes (drafting), Victor Gibbs (editorial review and final formatting), and Chris Lowry (report assembly and production). Many thanks to the GMI staff for taking computer files with the report and tables in different formats, a pasted-up draft report, poor xerox copied maps and drawings, and an assortment of good and poor quality photographs and putting it all together into the quality product you see here.

The following people provided photographs, data, or information which added greatly to this report. Marshall Hunter from the White Sands Missile Range (WSMR) Museum loaned the historic Tularosa Peak facility photographs for reproduction. Bob Burton, WSMR archeologist, explained the history of the Aerobee launch tower's move from HAFB to WSMR. George House, curator at the International Space Hall of Fame in Alamogordo, loaned an original copy of the Alamogordo Army Air Base booklet for reproduction. Robert M. Leavitt of Knight and Leavitt Associates (Las Vegas, Nevada) provided invaluable data on the Flexible Gunnery Target Arrays near Nellis AFB, as well as a reference for a report on the subject. Susan Murphey of the Harry Reid Environmental Center at the University of Nevada, Las Vegas, kindly reproduced that report. Jerome A. Greene, National Park Service (Denver, Colorado), discussed his work on Cold War facilities at Hill AFB, Utah, and sent copies of site forms and report chapters. Dr. Rebecca H. Cameron, historian with the Center for Air Force History (Bolling AFB, Washington, D.C.) talked with me about WW II and Cold War issues and directed me to *The Army Air Forces in World War II* (the "Blue Books"), which was the major reference for the WW II context. Dr. Paul Green, Headquarters Air Combat Command cultural resource manager, authorized additional funding to complete this unfinished Legacy project and worked with me on determining National Register eligibility recommendations for five WW II and Cold War properties in that gray area of significance.

On a more personal note my father, Chaplain Lt. Col. (Retired) Lawrence V. Tagg, located and sent numerous articles and references on HAFB and the various types of aircraft flown at the base during WW II. He also took the time to provide comments on the first draft of the historic context, as well as answering many questions throughout the report writing process on WW II and Cold War issues. His Air Force background and knowledge of military history were invaluable in helping me sort out and organize the historic context. Last but not least my wife, Lori, was there both professionally and personally through the entire project. She gave encouragement and support when it was most needed, edited or commented on portions of all drafts (including the in-depth final edit), and put up with constant complaints and questions as the end drew near. Lori is my harshest critic and best friend, and I couldn't have done this without her.

LISTS OF ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

MILITARY AND GENERAL ACRONYMS AND ABBREVIATIONS

This publication consists of a discussion of military history and facilities, with many military and cultural resource acronyms and abbreviations used heavily throughout. These acronyms/abbreviations, taken from a variety of military and professional publications and documents, are listed below, followed by those specific to the facilities.

AAAB	Alamogordo Army Air Base
AAAF	Alamogordo Army Air Field
AAC	Army Air Corps
AAF	Army Air Field
AAFB	Alamogordo Air Force Base
ABM	Anti-Ballistic Missile System
ABGR	Alamogordo Bombing and Gunnery Range
ACC	Air Combat Command
ADC	Air Defense Command
ADN	*Alamogordo Daily News*
AF	Air Force
AFB	Air Force Base
AFL	Aeromedical Field Laboratory
AFMC	Air Force Materiel Command
AFMDC	Air Force Missile Development Center
AFSC	Air Force Systems Command
AMC	Air Materiel Command
AMSL	above mean sea level
AN	*Alamogordo News*
ARDC	Air Research and Development Command
ARL	Aeromedical Research Laboratory
BLM	Bureau of Land Management
BOQ	Bachelor Officers' Quarters
BQM	Bomber (B) modified for use as a target or drone (Q), guided (M)
BWWSA	Boles Wells Water System Annex
C^3I	Command, Control, Communications and Intelligence
CCTS	Combat Crew Training Station
CES	Civil Engineer Squadron
CEV	Environmental Flight

CIGTF	Central Inertial Guidance Test Facility
COE	U.S. Army Corps of Engineers
CONUS	Continental United States
DoD	Department of Defense
DEW	Distant Early Warning
FW	Fighter Wing
FY	Fiscal Year
GAM	Guided Aircraft Missile
Gapa	Ground-to-Air Pilotless Aircraft
GHQ	General/Group Headquarters
GMI	Geo-Marine, Inc.
GPS	Global Positioning System
HABS/HAER	Historic American Building Survey/Historic American Engineering Record
HADC	Holloman Air Development Center
HAFB	Holloman Air Force Base
HAM	Holloman Aero Med
HAR	Holloman Archaeological Resource (HAFB archaeological site number prefix)
HPD	Historic Preservation Division
HPP	Historic Preservation Plan
HSR	Human Systems Research, Inc.
HSTT	High Speed Test Track
HQ	Headquarters
HTS	Horizontal Test Stand
IA	Interagency Agreement
ICBM	Intercontinental Ballistic Missile
IRBM	Intermediate Range Ballistic Missile
IRP	Installation Restoration Program
JB	Jet Bomb
LA	Laboratory of Anthropology (New Mexico archaeological site number prefix)
LRMP	Legacy Resource Management Program
MAC	Military Airlift Command
MAD	Mutually Assured Destruction
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MTSA	Missile Test Stands Area
MX	Missile, experimental
NASA	National Aeronautics and Space Administration
Nativ	North American Test Instrument Vehicle
n.d.	no date
NHPA	National Historic Preservation Act
NM	New Mexico
NPS	National Park Service
NRHP	National Register of Historic Places

NSC	National Security Council
OQ	Unmanned aerial target
OTU	Overseas Training Unit
POW	prisoner of war
PRL	Primate Research Laboratory
RAF	Royal Air Force
RATSCAT	Radar Target Scatter Test Facility
SAC	Strategic Air Command
SALT	Strategic Arms Limitation Treaty
SDI	Strategic Defense Initiative
SEATO	Southeast Asia Treaty Organization
SF	Square feet
SHPO	State Historic Preservation Officer
TAC	Tactical Air Command
TFW	Tactical Fighter Wing
TM	Tactical Missile
TO	Theater of Operations
TS	Test Stand
UN	United Nations
U.S.	United States
USAAF	United States Army Air Forces
USACERL	United States Army Construction Engineering Research Laboratory
USAF	United States Air Force
U.S.S.R.	Union of Soviet Socialist Republics (now Russia)
WAAC	Women's Army Auxiliary Corps
WAC	Women's Army Corps
WSMR	White Sands Missile Range
WSPG	White Sands Proving Ground
WW	World War (I and II)
X	Experimental
XQ	Experimental (X) aircraft modified for use as target or drone (Q)
XSM	Experimental (X) strategic missile (SM)
ZEL	Zero Length
YOQ	Service Test/prototype (Y) unmanned aerial target

FACILITY SPECIFIC REAL PROPERTY ACRONYMS AND ABBREVIATIONS

The acronyms and abbreviations for facilities are based on those found in the Real Property Category Codes list (24 March 1994) and through discussions with HAFB Real Property officer Diana Moya (personal communication 1997). Construction terms came from Sonya Cooper and Jean Fulton. In some cases, there is more than one meaning for an acronym and both are listed, divided by a slash. There are also cases where more than one acronym/abbreviation was used for the same word; if the difference is one letter it is included in brackets, but if the acronym is substantially different it is included separately. Finally, the true meanings of a few acronyms/abbreviations could not be located; a question mark indicates the meaning is unknown, and the associated building is listed in parentheses; a question mark with a definition followed by a question mark indicates an educated guess by the author and should be viewed with caution. Many of these acronyms and abbreviations are found only on the facility assessment forms and not in the text.

A, B and C	Less hazardous munitions such as those without explosive projectiles, fuse lighters, distress signals, etc.
A/C	Aircraft
AC	Aircraft/Academic Classroom
ACT	Action
ADAL	? (Building 322)
ADMIN	Administration
AF	Air Force
AG	Above Ground
AGE	Aircraft Ground Equipment
A/M	Aircraft Maintenance? (Building 300)
A/SE	Aircraft Support Equipment
ASMB	Assembly
ASSY	Assembly
BE	Base Engineer
BLDG	Building
BSE	Base
B/U	Built-up
BUR	Built-up roof
C-Stor	Central Storage
CAT	Combat Arms Training
CE	Civil Engineer
CMU	Concrete masonry units
CV	Covered
ENG	Engine/Engineer/Engineering
ENGR	Engineer
EQUIP	Equipment
EXCH	Exchange
FAC	Facility
FAM	Family
FCLT[Y]	Facility
FLD	Field
GAR	Garrison (Building 1237)

GP	Group
GRND	Ground
GSE	Ground Support Equipment
HG	Hangar/Headquarters Group? (Building 291)
HQ	Headquarters
I	Inspection
I/D	Indoor? (Building 599)
INSTM	Instrument
LCH	Launch
LIB	Library
M	Missile (possibly another meaning for Building 107)
M/A	Medium Aircraft
MAG	Magazine
MAINT	Maintenance
MGT	Management
MNT	Maintenance
MSL	Missile
MWR	Morale, Welfare, and Recreation
NAF	Non-appropriated Funds
NAV	Navigational
O	Outdoor
OFC	Office
ORG	Organization
PAV	Paving
R	Repair
RECTN	Recreation
REPR	Repair
RKT	Rocket
RLSE	Release
RSCH	Research
SA	Small Aircraft
S/A	Small Aircraft
SAMTU	Small Arms Maintenance and Training Unit? (Building 599)
SERV	Services
SHP	Shop
SP	Security Police
SPT	Support
STN	Station
STOR	Storage
SUP[P]	Supply/Supplies
SYS	System
TECH	Technical
T&G	Tongue-and-groove
THODLITE	Theodolite
TNG	Training/Transit
TRNG	Training

WHSE	Warehouse
WPN	Weapon

REAL PROPERTY AND CULTURAL RESOURCES DEFINITIONS

The National Park Service (NPS) provides a classification system for evaluating the National Register of Historic Places (NRHP) significance of cultural resources (NPS 1991c). The USAF provided military examples of some of these classifications in their *Interim Guidance for the Treatment of Cold War Properties for USAF Installations* (USAF 1994:64). In addition, there are terms used on a military base such as HAFB that are used to discuss Real Property. Finally, all military buildings are designated as to type of construction, which is related to their expected life span. The terms defined below are used in this publication.

Building — "A building, such as a house, barn, church, hotel, or similar construction, is created principally to shelter any form of human activity. 'Buildings' may also be used to refer to a historically and functionally related unit, such as a courthouse and jail or a house and a barn" (NPS 1991c:4). Military examples include administration buildings, chapels, dormitories, family housing, garages, hangars, launch control centers, libraries, and radar stations (USAF 1994:64).

Facility — *Merriam Webster's Collegiate Dictionary* (tenth edition 1993) defines 'facility' as "something (as a hospital) that is built, installed, or established to serve a specific purpose." It is used here as a catchall term to describe those resources that would or could be included on the HAFB Real Property list and includes both buildings and structures as a group.

Feature — This term is used to describe nonportable objects on archaeological sites. For military sites, these can include intact buildings and

	structures but may also consist of concrete pads, instrument stands, depressions (i.e., resulting from use as an outhouse or foxhole), rock alignments, and so forth.
Historic Property	Any prehistoric or historic district, site, building, structure, or object included on, or eligible for inclusion to, the NRHP. This term includes artifacts, records, and remains related to and located within such properties. The term "eligible for inclusion in the National Register" includes both properties formally determined as such by the Secretary of the Interior and all other properties that meet NRHP listing criteria (36 CFR 800.2(e)).
Permanent (P)	A Real Property term used to describe the construction type of a facility suitable and appropriate to serve a specific purpose for a maximum period of time (at least 25 years) and with minimum maintenance (Aurora Arrieta, HAFB Real Property Office, personal communication 1997). During WW II, permanent construction was intended for use after the war and was typically built of masonry (brick, tile, or concrete) and metal frame (Whelan et al. 1997:12).
Property	A catch-all term that includes both buildings and structures as a group.
Real Property	A catch-all term that includes both buildings and structures.
Resources	A catch-all term that includes both buildings and structures.
Semipermanent (S)	A Real Property term used to describe the construction type of a facility suitable and appropriate to serve a specific purpose for a limited period of time (less than 25 years but more than five) and with a moderate to high degree of maintenance (Aurora Arrieta, personal communication 1997). During WW II, semipermanent

construction was often the result of a compromise between the desire for a permanent facility and shortages of time and material, and typically consisted of cinderblock or wooden frame clad with synthetic siding, or a mixture of wooden frame and masonry (Whelan et al. 1997:12).

Site	"A site is the location of a significant event, a prehistoric or historic occupation or activity, or a building or structure, whether standing, ruined, or vanished, where the location itself possesses historic, cultural, or archaeological value regardless of the value of any existing structure" (NPS 1991c:5). The term, as it is used in this publication, refers to archaeological sites, which consist of more than one or a combination of associated buildings, structures, features, and artifacts. Examples at HAFB include launch complexes and instrumentation stations.
Structure	"The term 'structure' is used to distinguish from buildings those functional constructions made usually for purposes other than creating human shelter" (NPS 1991c:4). Military examples include bridges, missile silos, launch pads, roads, runways, water towers, and wind tunnels (USAF 1994:64).
Temporary (T)	A Real Property term used to describe the construction type of a facility suitable and appropriate to fill a need for a short period of time (five years or less) without regard to degree of maintenance, the designs and details of which provided minimum facilities with maximum initial economies (Aurora Arrieta, personal communication 1997). During WW II, temporary construction consisted of wooden frame buildings, typically built according to standardized plans, and modular metal buildings that were not intended for use after the war (Whelan et al. 1997:12).

ABSTRACT

In 1995 and 1996, architectural assessments were conducted on 34 buildings and structures to determine their potential eligibility for inclusion to the National Register of Historic Places as part of the Legacy Resource Management Program. These resources were built on Holloman Air Force Base between 1942 and 1962. Eighteen World War II facilities, all that existed on the base, and 16 early Cold War properties (including all those from the 1940s except for housing units) were evaluated using Historic American Building Survey/Historic American Engineering Record Level IV documentation. Facility assessment forms were completed and National Register of Historic Places eligibility recommendations were provided for each property based on historic context, integrity, and its contribution to significant archaeological sites. In addition, all previously conducted projects that dealt with either facility assessments and evaluations or provided historic data on the 34 properties were discussed to provide an overall review of the type of work completed on Holloman Air Force Base to date.

At the completion of the project, 17 properties were recommended eligible for inclusion to the National Register of Historic Places (14 Cold War and three World War II) and 17 as not eligible (15 World War II and two Cold War). Most of the World War II facilities have been heavily modified and lack integrity, and the base retains no feeling of its war years as a United States Army Air Forces Heavy and Very Heavy bomber aircrew training post. In contrast, the Cold War facilities are highly intact, and a number of missile testing and instrumentation complexes in the remote areas of the base provide a feeling for that time when the base was one of the primary missile development and research facilities in the United States.

CHAPTER 1

INTRODUCTION

Holloman Air Force Base (HAFB) is located on the eastern edge of White Sands Missile Range (WSMR) within the Tularosa Basin of south-central New Mexico. These two military installations played important roles in the United States efforts toward "Man In Space" and the maintenance of the defense posture of this country. The onset of World War (WW) II was responsible for the establishment of the Alamogordo Bombing and Gunnery Range and Alamogordo Army Air Field (now HAFB), which was integrated with White Sands Proving Grounds (now WSMR) at the end of war. Subsequently, early Cold War technology development efforts were carried out at these two installations. Many of the facilities constructed and used for the base mission remain as a legacy to the HAFB role in these two important world events. As the military mission at HAFB expands and changes, new requirements leave many of the early buildings and structures defunct, and attrition and demolition are taking their toll. Thus, the documentation and evaluation of these properties have become a major focus of the base cultural resources program. Secretary of the Air Force Sheila E. Widnall has stated, ". . . it is important that we preserve our historic buildings and districts, while maintaining their usefulness to fulfill our mission in the 21st century" (Wagner 1996:back cover).

As part of the Legacy Resource Management Program (LRMP), an architectural assessment project was initiated in 1993 to evaluate a portion of the HAFB buildings and structures. The overall goal of the project was to comply with Section 110 of the National Historic Preservation Act (NHPA) of 1966 which requires federal agencies to inventory historic properties and determine their eligibility for the National Register of Historic Places (NRHP). To meet this goal, the focus of the project was to create a standard facility assessment format, develop an historic context for HAFB, and evaluate the significance of 34 WW II and early Cold War facilities identified in the HAFB Historic Preservation Plan. The facilities were to include those built in the 1940s, with the exception of housing units, and a select few from the 1950s and 1960s that were known to be unique or significant. The original project, conducted between 1994 and 1995, was not completed (see Preface). During that same time period, other projects accomplished some of the tasks from the original Scope of Work. A HAFB-specific facility assessment form was developed as part of the second phase of the project, which focused on buildings and structures constructed between 1950 and 1960 (Fulton and Cooper 1996). In addition, a preliminary reconnaissance of Cold War resources at Air Combat Command (ACC) bases initiated by Headquarters (HQ) resulted in a nation-wide Cold War historic context which was valid for HAFB facilities (Lewis et al. 1995).

As a result of these projects, the scope for the completion of the HAFB architectural assessment project was reduced. The newly developed HAFB facility assessment form was available for the evaluations and, because a Cold War context already existed, only a WW II historic context was established. The facilities originally listed for evaluation also changed. Additional 1940s facilities were added to the list, and a number of the early 1950s buildings were dropped because they had been evaluated during the second phase of the work due to their association or functional similarity with facilities in that project.

In 1996, 18 WW II and 16 early Cold War facilities were investigated through a contract with Geo-Marine, Inc. (GMI). The WW II buildings and structures, all that remain from 1942 through 1944, included four aircraft hangars, six warehouses or storage buildings, four administrative offices or classrooms, a dormitory, a small arms range building, a shop, and a training range (Table 1). No buildings built in 1945 remain on the base. The Cold War buildings and structures represent only a portion of the facilities constructed between 1947 and 1962. These facilities were judgmentally selected for evaluation based on two criteria: (1) construction in the late 1940s or (2) unique construction and association with known missile development programs. They include seven missile launch facilities (four buildings and three structures), four instrumentation buildings, a bathhouse, a rocket fuel incinerator, a radio relay building, a storage building, and a rocket assembly building. Thirteen of the 34 facilities are within the boundaries of documented archaeological sites.

The architectural assessment involved a four-part process: (1) inventory existing building blueprints and drawings to determine original layout and subsequent modifications; (2) conduct a field assessment, including photo documentation, to determine structural integrity and modifications not noted on blueprints; (3) conduct archival research to develop a history of the facility; and, (4) complete the facility inventory form. Once this process was completed, NRHP eligibility recommendations were made for each property using the NRHP criteria and the guidelines established in the United States Air Force's (USAF) *Interim Guidance for the Treatment of Cold War Historic Properties for U.S. Air Force Installations* (hereafter referred to as *Interim Guidance*) (USAF 1994).

This report represents the final documentation for the first phase of the historic architectural assessment. To set the stage for the facility evaluations, the report presents a discussion on the general environmental setting and previous research conducted on the base (Chapter 2) and the theoretical considerations and methods (Chapter 3). Chapter 4 provides a national historic context and the history of HAFB as it

Table 1
Facilities with Construction Date and Original and Current Use

HAFB Facility #	Completion Date (19__)[1]	Original Use[2]	Current Use (Last Use)[3]
40	43	Classroom, Academic School Bldg	Family Support Center
71	43	Storage, Civil Engineer Covered	Family Housing Management Office
96	43	Warehouse, Base Supply and Equipment	Housing Supply and Storage Facility
107	43	Classroom, Academic	Vacant (Substance Abuse, German AF Admin)
200	43	Office, Administrative	Demolished (Thrift Shop)
205	43	Office, Administrative	Base Recreation Library
218	43	Dormitory, Airmen's	Thrift Shop
289	43	Warehouse, Base Hazard and Flammable	Shop, Aircraft Support Equipment Storage
291	43	Hangar, Field Maintenance	Maintenance Dock, Small Aircraft
300	43	Hangar, Field Maintenance	Shop, Jet Engine Inspection and Maintenance
301	44	Hangar, Field Maintenance	Maintenance Dock, Small Aircraft
302	42	Shop, Base Engineer	Squadron Operations, Education Facility
322	49	Bathhouse, Swimming Pool	Recreation Center/ Health and Wellness
599	43	Range, Small Arms 1000 inch	Demolished (CAT Maintenance)
754	43	Shed, Civil Engineer Storage	Demolished (Miscellaneous Outdoor Recreation Facility)
900	54	Missile Theodolite Station	Navigational Aid Tower
1079	43	Hangar, Field Maintenance	Maintenance Dock, Small Aircraft
1113	49	Radio Relay Facility	Vacant (Radio Relay Facility)
1116	47	Test Facility, Missile Launching	Vacant (Morale, Welfare and Recreation [MWR] Supply/Nonappropriated Fund [NAF] Central [C] Storage)
1127	55	Storage, Base Rocket Assembly	MWR Supply/NAF C-Storage
1133	54	Missile Theodolite Station	Vacant (Missile Theodolite Station)
1139	47	Test Facility, Missile Launching	MWR Supply/NAF C-Storage
1142	50	Test Facility, Missile Launching	Exchange, Retail Warehouse
1236	43	Storage, Base, Explosives	Storage, Spare, Inert
1237	43	Storage, Base, GAR	Storage, Magazine Above-ground A, B and C
1249	54	Missile Theodolite Station	Vacant (Missile Theodolite Station)
1284	48	Missile Instrumentation Station	Vacant (Missile Instrumentation Station)
1285	50	Storage, Research Equipment	Research Equipment Storage
1440	62	Missile Launching Facility	Civil Engineer Storage
1442	59	Missile Launch Facility	Vacant (Civil Engineer Storage)
Incinerator	ca. 50	Fuel Incinerator	Abandoned
Test Stand	ca. 55	Test Stand, Captive(?)	Abandoned
JB-2 Ramp	47	Test Facility, Launching Ramp	Abandoned
Jeep Target	ca. 43	Small Arms (.50 caliber) Training Range	Prime Beef Training Area

1 from Real Property Accountable Record (USAF Form 1430) and research
2 from Real Property Accountable Record, original facility drawings, and research
3 from USAF Real Property Inventory List (1/14/97) and field assessments

fits into the context. These histories explain why and how facilities were constructed as they were through time. In Chapter 5, the facilities are then described by type, based on the Cold War Historic Property Type list developed in the USAF *Interim Guidance*, in which WW II properties also fit. A few property types were added to the list from *Historic Context for Department of Defense World War II Permanent Construction* (Whelan et al. 1997) for facilities from that era that didn't fit under existing types. This section includes a more in-depth history of the activities associated with each facility type. Finally, there is a discussion of general functional and modification trends and construction types through time, with insight into both unique and common architectural styles (Chapter 6). Chapter 7 provides a summary and NRHP recommendations, as well as a management guide to assist HAFB in caring for its historic properties.

The data presented here provide an overview of the history of HAFB as evidenced through the buildings and structures constructed during WW II and the early Cold War era. In most cases, these properties are the only remaining physical evidence of the important role HAFB played during the two major world events that have helped shape today's modern U. S. Air Force.

CHAPTER 2

PHYSICAL SETTING AND PREVIOUS RESEARCH

PHYSICAL BACKGROUND

Project Location

HAFB is located in the Tularosa Basin of south-central New Mexico, approximately seven miles southwest of Alamogordo (Figure 1). The Main Base covers 52,073 acres, with an additional 7,566 acres of noncontiguous lands in the Boles Wells Water System Annex (BWWSA) and Bonito Pipeline. The Tularosa Basin is largely administered by federal agencies, with HAFB bounded by WSMR on the northeast, north, west, and southwest and on the south by White Sands National Monument (WSNM) and Bureau of Land Management (BLM) property. Intermixed private, state, and BLM lands lie to the east (Mattson and Tagg 1995:5).

Tularosa Basin Environment

The Tularosa Basin consists of a closed alluvial landform surrounded on the north, east, and west by high, rugged, fault block mountain ranges. Topography within the basin includes white gypsum sand dunes, lava fields, upland flats, alluvial fans, deeply cut draws, and playas or ephemeral ponds. HAFB lies on the lower, relatively flat alluvial plains below the Sacramento Mountain piedmont and is bordered on the west by the White Sands dune field. Elevations range from 4,000 to 4,200 feet above mean sea level (amsl). Tularosa Peak, a small volcanic plug rising to an elevation of 4,398 ft amsl, is a prominent landmark at the north end of the base. Water sources consist of several intermittent streams crossing the base from northeast to southwest and a number of ephemeral springs located along an active fault line. Playas, possibly representing Late Pleistocene lakebeds, are scattered throughout the basin and collect water during the summer rain storms (Doleman 1988:9; Hawthorne 1994:5-7; Mattson and Tagg 1995:5).

The climate in the Tularosa Basin is arid with hot summers and mild winters. The mean annual temperature is about 61° F, with 90° F or higher common in the summer months and freezing temperatures not uncommon in the winter. Less than 10 inches of rain falls annually, most in the

Figure 1. Holloman Air Force Base, location and vicinity map

(adapted from Weitze 1997:12).

Figure 1. Holloman Air Force Base, location and vicinity map (adapted from Weitze 1997:12).

pronounced summer monsoons. Soils are mainly of the Holloman-Yesum gypsum land-Yesum type, which is a sandy loam high in saline and gypsum content. Chihuahuan desert scrub, the main vegetative community found throughout the basin, is dominated by creosote bush, mesquite, four-wing saltbush, rabbitbrush, tarbush, crucifixion thorn, annual grasses, and various cacti. Tamarisk, or salt cedar, is a recent invader and is associated with cottonwood near water sources. Fauna consists mainly of small to medium-sized mammals, reptiles, and birds. These include coyote, cottontail and jackrabbit, badger, various rats and mice, snakes, and lizards (Hawthorne 1994:8; Mattson and Tagg 1995:5-6).

Military Potential

The natural and political setting of the Tularosa Basin played a large part in the use of HAFB as a Heavy and Very Heavy bomber crew training base in WW II and guided missile test facility during the Cold War. With U.S. involvement in WW II, the military expanded the number of training facilities and bombing ranges. In locating the ranges, the U.S. Army Air Forces (USAAF) made a determined effort to use only the least productive land available. In 1941, because of the sparse population and large tracts of public domain, the Tularosa Basin proved to be a perfect location for the Alamogordo Bombing and Gunnery Range (Futrell 1955:161; Hawthorne 1994:23; Mattson and Tagg 1995:6).

As early as 1943, the unique facilities and physical environment of the isolated installation were considered as a location for a guided missile research and development program. No effort was made, though, to interfere with the Heavy bomber crew training program which was then in force (Meeter 1967:185). Instead, the USAAF carried out guided missile research and development testing in other places throughout the U.S. such as western Florida, southern California, southern Nevada, and south-central Utah. After the war, these programs were abandoned for a number of reasons. When the Alamogordo/White Sands area became available in 1946, Air Materiel Command took steps to move the programs there because "it is the only area suitable for the purpose . . .

within the borders of the United States. The nature of guided missile testing demands an area that is large and relatively free of habitation . . . and remote from large areas of population. It must be fairly level because of the necessity for extensive range instrumentation and missile recovery. The weather must be such as to facilitate year round operation, and the visibility must be exceptional" (Sands 1949).

By 1947, what had been considered by early geologists, such as Thomas MacBride in 1904, as "a convenient little desert" (Hawthorne-Tagg 1997:21) had become first a vast bombing range during WW II and then a USAAF missile testing base. The facilities investigated for this report represent the legacy of the base's contribution to the nation's defense in the past 50 years and are the focus of ongoing architectural assessments designed to evaluate and protect this resource type.

PREVIOUS RESEARCH

Documentation and assessments of historic facilities have occurred on HAFB in the past three years through projects sponsored by the base and HQ ACC. HAFB, through the LRMP, initiated a program that focused on the evaluation of all installation buildings and structures constructed during WW II and the Cold War. The intent of this work was twofold: to evaluate structures for their NRHP eligibility so they can be managed and protected as required by Section 110 of the NHPA of 1966, as amended; and to assist planners in the Environmental Impact Analysis Process so mission essential projects progress without delays. In addition, five buildings were assessed as part of mission related projects as required by Section 106 of the NHPA. During this same time period, HQ ACC focused on the management of Cold War properties on ACC bases and sponsored initial historic property evaluations as part of this process.

These assessment projects are discussed below and illustrated in Table 2, with a complete list of the individual facilities presented in Appendix A. The table and appendix show buildings and structures investigated and NRHP recommendations from each project. The assessments and evaluations from those projects conducted prior to the 1995 Historic Architectural Assessment II project (Fulton and Cooper 1996) did not include Historical

American Building Survey/Historic American Engineering Record (HABS/HAER) level facility documentation or fulfill Section 110 requirements. They do, however, provide a background for future evaluations of WW II and Cold War resources at HAFB.

Many of the Cold War facilities were originally recorded as part of archaeological sites or as isolated military features during cultural resources inventories. Archival research was then conducted on the sites and buildings during two LRMP projects (Kammer 1996; Mattson and Tagg 1995), and a third research project provided historic data on many of the facilities (Weitze 1997). Because much of this information is valuable for the evaluation of the buildings, the archaeological and research projects are also discussed here. Archaeological sites are designated by Holloman Archaeological Resource (HAR) and New Mexico Laboratory of Anthropology (LA) site numbers.

Facility Assessment Projects

Six projects that included some type of building and structure assessments and/or NRHP evaluations have been conducted on HAFB. Three projects consisted of HABS/HAER Level IV documentation of facilities, two were reconnaissance level investigations, and one assessment/reconnaissance investigation was not completed.

Table 2
Previous Facility Investigations and National Register Recommendations

			NRHP Recommendations				
Reference	Investigation Level/ Type	# Bldgs	Eligible	Potentially eligible	Ineligible	N/A[1]	Other
Eidenbach 1994	Reconnaissance	55	19	6	18	11	1 National Landmark
Lewis and Staley 1994	Reconnaissance	~133	27	7	0	99	0
Eidenbach and Wessel 1995	Assessment/ Reconnaissance	24	24	0	0	0	0
Fulton and Cooper 1996	Assessment	73	11	21[2]	41[3]	0	0
Ernst et al. 1996	Assessment	3	0	0	3	0	0
Tagg 1996	Assessment	2	0	2	0	0	0
Tagg 1993a	Archaeology	1	0	1	0	0	0
Tagg 1993b	Archaeology	1	0	1	0	0	0
O'Leary 1994	Archaeology	6	0	6	0	0	0

Michalik 1994	Archaeology	1	0	0	1	0	0
Mattson and Tagg 1995	Research/ Archaeology	12	0	12	0	0	0
Sale et al. 1996	Archaeology	1	0	0	1	0	0
Kammer 1996	Research	3	3	0	0	0	0
Sale 1997	Archaeology	7	7	0	0	0	0
Weitze 1997	Research	8	N/A	N/A	N/A	N/A	N/A
Totals[4]		330	91	56	64	110	1

[1] N/A indicates no evaluation was made
[2] the 21 potentially eligible sites are not currently eligible, but may be when they reach the 50 year mark
[3] of the 41 ineligible sites, 13 were not considered eligible as individual properties, but might be contributing elements to a district or thematic nomination
[4] includes many facilities investigated more than once

HAFB Historic Preservation Plan

Between 1992 and 1994, Human Systems Research, Inc. (HSR) personnel produced the HAFB Historic Preservation Plan (HPP), which included a list of “potentially historic military real property built prior to 1950 or identified as eligible” (Eidenbach 1994: Appendix G). The list was produced from HAFB real property records and NRHP recommendations were based on visual impressions without formal investigations or assessments. Fifty-five facilities or groups of facilities (such as housing units) constructed during WW II and the early Cold War were listed (see Table 2 and Appendix A). NRHP recommendations were made on 43 facilities with 19 determined eligible, six potentially eligible, and 18 ineligible. The remaining facilities included one National Landmark eligible property (the High Speed Test Track), three which had been demolished but were still on the most updated Real Property list, and eight that were not evaluated. This plan is currently outdated and is being rewritten by GMI.

HQ ACC Cold War Cultural Resource Inventory

In 1992, Gary Vest, then Deputy Assistant Secretary of the Air Force for Environment, Safety, and Occupational Health, asked the USAF Civil Engineer to coordinate the development of a policy regarding Cold War resources and scientific and technical equipment. In 1993, in direct response to this request, HQ ACC developed the *Interim*

Guidance (USAF 1994:61-71) and initiated a command-wide baseline assessment of potential Cold War historic resources (Lewis et al. 1995). The systematic study of ACC Cold War material culture was funded partially by the LRMP and was conducted by TRC Mariah Associates, Inc. It was completed in three parts: (1) development of an historic context and assessment methodology (Lewis et al. 1995); (2) preliminary evaluation of important Cold War real property, personal property, and records and documents at 27 ACC bases that would be recorded in base-specific reports (Lewis and Staley 1994); and (3) completion of a summary report with recommendations for a programmatic agreement between the USAF and the Advisory Council on Historic Preservation (Roxlau and Roxlau 1995). The project was meant to develop a baseline and overview of Cold War resources on ACC bases rather than provide a complete assessment of individual facilities.

In 1994, TRC Mariah conducted a reconnaissance visit to HAFB (Lewis and Staley 1994). They developed an historic land use context and conducted reconnaissance inventories of approximately 133 facilities. The full spectrum of facility types, ranging from support structures (such as dining halls and dormitories) to those related to specific Cold War functions (such as research and missile testing facilities), were investigated. The assessment process was informal and consisted of interviews with base personnel, review of real property records, and visual inspection of representative real property types. Facilities were evaluated based on an expanded version of the USAF Cold War property types list prepared earlier in the project (Lewis et al. 1995:113).

Thirty-four properties were identified as having played an important role within the Cold War context and were recorded in further detail and evaluated for NRHP eligibility (see Table 2 and Appendix A). The majority of those properties related to research, development, and testing between 1947 and 1968. No recommendations were made on the remaining 99 facilities. TRC Mariah's recommendation categories included (with corresponding NRHP terminology in parentheses): (1) no further work (ineligible); (2) stewardship (potentially eligible); (3) NRHP listing (eligible); (4) further documentation (not enough information to make a determination); and (5) preservation/conservation/repair (buildings in any category which required attention).

Of the 34 buildings evaluated, 27 were considered eligible and seven potentially eligible for the NRHP. Seventeen of these facilities had been evaluated in the HPP and recommendations were the same except in two cases. Eidenbach (1994) considered Building 1079 eligible and the High Speed Test Track (39710) a National Landmark eligible property, while TRC Mariah evaluated them as, respectively, potentially eligible and eligible to the NRHP.

Historic Architectural Assessment I

In 1994, HSR was contracted through the New Mexico HPD to conduct a LRMP project consisting of HABS/HAER Level IV documentation of 20 facilities and approximately 70 family housing units (investigated as a group, not as individual units) chosen from the HPP Potentially Historic Military Real Property List. Two WW II buildings “not examined” in the HPP (Buildings 1236 and 1237) and one Cold War building (Building 1440) were added to that list at a later time. The focus of the project was to create a HAFB-specific HABS/HAER Level IV building assessment form and complete more in-depth assessments of all 1940s and some of the more significant early Cold War facilities to verify the NRHP recommendations made in the HPP. HSR completed some historic research, archaeological mapping and investigations of the Missile Test Stands Area (HAR-041/LA 104274) and Able 51 (HAR-075/LA 107799), and limited architectural assessments of less than half of the buildings. All 23 buildings and the housing units were considered eligible for the NRHP (see Table 2 and Appendix A). Sixteen of the recommendations remained the same as those made in the HPP, five changed, and three were new: Buildings 2101 through 2188 (housing units), 2204, 2206, and 2207 were originally considered potentially eligible; the High Speed Test Track (39710) was originally considered National Landmark eligible; and Buildings 1236, 1237, and 1440 were not evaluated in the HPP.

A draft report was completed documenting the project and providing the NRHP recommendations (Eidenbach and Wessel 1994). This report and the facility assessment forms were not accepted by HAFB or the HPD because they were incomplete and did not fulfill the project scope (Tagg 1995a; Taylor 1996). For this reason, the recommendations made in the report were not considered valid, and additional funding was acquired to ensure completion of the project.

Historic Architectural Assessment II

In 1995, LRMP funding was provided to document and assess 75 Cold War buildings constructed prior to 1957 (Fulton and Cooper 1996). A few buildings constructed through 1960 were also assessed because of their association with the Primate Research Laboratory complex. Because the Architecture I project was not completed, this project also resulted in development of the HAFB-specific HABS/HAER Level IV facility assessment form and documentation methodology for future projects. In addition, because of contextual similarities in facilities, some of the buildings from the first project were addressed in this project and vice versa and 73 buildings were eventually documented. The assessment included review of existing real property records and engineering drawings and extensive field documentation of the facilities. Many of the buildings were associated with the Primate Research Laboratory and the High Speed Test Track.

Three categories of eligibility were recognized for the facilities because they were less than 50 years old. In addition to being either eligible or ineligible, some facilities were identified as needing further evaluation when they reached the 50 year mark. These facilities were considered potentially eligible. Of the 73 facilities finally evaluated, 11 were considered eligible for the NRHP; 21 were not currently eligible but had the potential to become eligible when they reach the 50 year mark (potentially eligible); and 41 were ineligible as individual properties, with 13 of these contributing elements for possible district or thematic nominations (see Table 2 and Appendix A). Thirteen buildings had been previously evaluated either in the HPP, HQ ACC Cold War

Inventory, or Architectural Assessment I projects. In all cases the recommendations were the same.

Buildings 107, 289 and 291 HABS/HAER Assessments

In 1996, three WW II buildings were scheduled for demolition as part of the German Air Force Beddown project. During previous projects, Building 107 had been identified as ineligible and Buildings 289 and 291 as eligible, but HABS/HAER documentation had not been completed on them (Eidenbach 1994; Eidenbach and Wessel 1995; Lewis and Staley 1994). For that reason, GMI personnel completed HABS/HAER documentation to determine their eligibility: Level IV documentation was completed for heavily modified Buildings 107 and 291, and Level I for Building 289 because it retained structural integrity and no engineering drawings existed (Ernst et al. 1996). The documentation included reviewing existing real property records and Civil Engineer building drawings, taking HABS/HAER quality photographs, and completing the field assessment form created by Fulton and Cooper (1996). Structural drawings were completed for Building 289. Following the investigations, all three buildings were determined to be ineligible for the NRHP: Buildings 107 and 291 lacked integrity and the Level I documentation exhausted the research potential of Building 289 (see Table 2 and Appendix A). They are currently on the demolition list.

Buildings 1236 and 1237 Roof Replacement

Also in 1996, HAFB proposed to replace deteriorating asbestos roof shingles on two WW II buildings located in the Munitions Storage Area. Buildings 1236 and 1237 had been considered eligible properties, but adequate HABS/HAER documentation had not been completed (Eidenbach and Wessel 1995). HABS/HAER Level IV documentation was completed for both buildings based on the evaluation process initiated by Fulton and Cooper (1996). The buildings were considered potentially eligible for the NRHP (Tagg 1996; see Table 2 and Appendix A). The records checks indicated the roof shingles had been replaced at some point after the original building construction, so the project was allowed to proceed and the shingles were replaced.

Archaeological and Research Projects

Three research and six archaeological projects resulted in the initial documentation and/or research of 14 of the WW II and Cold War facilities discussed in this report. These projects did not include formal assessments and NRHP recommendations were made only for the archaeological sites that contained the facilities. Weitze's 1997 project focused on missile and instrumentation research that involved all of the sites, but did not address NRHP issues. The projects are discussed here because they provide background histories of the sites and facilities. Table 3 illustrates the facilities that are part of archaeological sites and the project during which they were recorded.

Building 1249 (Sole Site) Disturbance

In 1992, the HAFB archaeologist conducted a damage assessment of Building 1249 (Sole site), a missile theodolite tower located in the northern part of the base (Tagg 1993a). The building was used for military maneuvers and had numerous bullet holes in the roof and doors and graffiti on the walls. During the project, the tower, 14 associated features, and a sparse aboriginal artifact scatter were recorded as an archaeological site (HAR-005/LA 99457). The site was considered potentially eligible for the NRHP under Criterion D based on its potential to provide information on both aboriginal and military use of HAFB and the Tularosa Basin (see Table 3).

Test Track Area Site Documentation

In 1993, the HAFB archaeologist and volunteer Lori Hawthorne documented three archaeological sites in the vicinity of the High Speed Test Track (Tagg 1993b). One of these was the Pritch site consisting of a missile theodolite tower (Building 1133) and 12 associated features (HAR-007/LA 99633). The site was considered potentially eligible for the NRHP because of its potential to provide information on the military use of HAFB (Criterion D; see Table 3).

High Speed Test Track/Missile Test Stands Area Survey

In 1994, HSR personnel conducted a cultural resources survey of the High Speed Test Track Quantity Distance Zone and the Missile Test Stands Area (O'Leary 1994). The second part of the project resulted in the documentation of the Missile Test Stands Area (HAR-041/LA 104274). This documentation

Table 3
Facilities Located in Archaeological Sites

HAFB Building #	Archaeological Site #	Archaeological Site/Feature Type	NRHP Eligibility for Site	Reference
900	HAR-018r (LA 107798)	Mart site/missile theodolite tower	Eligible	Mattson and Tagg 1995; Tagg 1995b; Kammer 1996
1113	HAR-041 (LA 104274)	MTSA/radio relay building	Eligible	Mattson and Tagg 1995; O'Leary 1994a; Sale 1997
1116	HAR-041 (LA 104274)	MTSA/Nativ observation shelter	Eligible	Mattson and Tagg 1995; O'Leary 1994a; Sale 1997
1127	HAR-041 (LA 104274)	MTSA/missile assembly building	Eligible	Mattson and Tagg 1995; O'Leary 1994a; Sale 1997
1133	HAR-007 (LA 99633)	Pritch site/missile theodolite tower	Eligible	Mattson and Tagg 1995; Tagg 1993b; Kammer 1996
1139	HAR-041 (LA 104274)	MTSA/Gapa observation shelter	Eligible	Mattson and Tagg 1995; O'Leary 1994a; Sale 1997
1142	HAR-041 (LA 104274)	MTSA/Aerobee observation shelter	Eligible	Mattson and Tagg 1995; O'Leary 1994a; Sale 1997
1249	HAR-005 (LA 99457)	Sole site/missile theodolite tower	Eligible	Mattson and Tagg 1995; Tagg 1993a; Kammer 1996
1440	HAR-075 (LA 107799)	Able 51/observation shelter	Potentially Eligible	Mattson and Tagg 1995; Tagg 1995b
1442	HAR-075 (LA 107799)	Able 51/missile hardsite	Potentially Eligible	Mattson and Tagg 1995; Tagg 1995b
no #	Isolated Military Feature 13	Rocket fuel incinerator	Ineligible	Sale et al. 1996
no #	HAR-041 (LA 104274)	MTSA/JB-2 launch ramp	Eligible	Mattson and Tagg 1995; O'Leary 1994a; Sale 1997
no #	HAR-041 (LA 104274)	MTSA/test stand	Eligible	Mattson and Tagg 1995; O'Leary 1994a; Sale 1997
no #	HAR-082 (LA 104440)	Jeep Target	Ineligible	Michalik 1994

consisted of identifying features and completing a detailed instrument map of the extensive early Cold War missile launch locale. Approximately 120 features were noted in the 325 acre site area, and four intact buildings and two structures were identified. These included three concrete blockhouses (Buildings 1116, 1139, and 1142), a missile assembly building (1127), a probable concrete test stand (unnumbered), and the JB-2 dirt launch ramp (unnumbered). A radio relay building (1113) was also within the site boundaries but was not mentioned in the report. HAR-041 was considered potentially eligible for the NRHP because of its association with early missile and rocket testing on HAFB that significantly contributed to the broad patterns of Cold War history (Criterion A), the distinctive characteristics of the building architecture (Criterion C), and the potential to yield further information on HAFB and the Cold War era in southern New Mexico (Criterion D) (see Table 3).

Air Base Ground Defense Exercise/Training Area Survey

Also in 1994, approximately 530 acres of land were surveyed for cultural resources by Archaeological Services by Laura Michalik (1994) for the Air Base Ground Defense Exercise/Training Area. During this project, a large WW II training area was documented which included the dirt-bermed Jeep Target (unnumbered; HAR-082/LA 104440). The site consisted of 13 features and thousands of military artifacts and was described as a post-1940 military target and gunnery training area used intensively for training up to the present. The site was considered ineligible for the NRHP because it was thoroughly recorded with no potential to yield further information (see Table 3).

Early Missile, Rocket, Instrumentation, and Aeromedical Program Research

Between 1994 and 1995, the International Space Hall of Fame and the HAFB archaeologist conducted a LRMP-funded research project that focused on early HAFB missile, rocket, instrumentation, and aeromedical research development (Mattson and Tagg 1995). Eleven programs consisting of six missile and rocket complexes, a series of instrumentation facilities, and four aeromedical research programs were investigated. Extensive research was conducted on each of the programs, and associated standing structures were described in detail. The missile, rocket, and instrumentation facilities consisted of physical remains and were investigated using cultural resources methods in addition to archival research. This resulted in the documentation of two new archaeological sites, re-evaluation of four previously documented sites, and discussion of two buildings not within a site. Ten buildings and two structures that are part of the current project, and the sites were researched (see Table 3). The two non-site buildings were 1159 and 1160 within the Horizontal Test Stand. They were originally part of the current project, but because of their association with the HSTT were investigated in the Architecture II project instead (Fulton and Cooper 1996).

The Mart site missile theodolite tower and Able 51 launch facility were recorded as archaeological sites during the research project (Tagg 1995b). The Mart site consisted of Building 900 and eight associated features (HAR-018r/LA 107798) and Able 51 included Buildings 1440 and 1442 and 30 features (HAR-075/LA 107799). Research was conducted on three previously recorded sites that contained intact buildings: the Missile Test Stands Area (MTSA) with Buildings 1113, 1116, 1127, 1139, 1142, and the Test Stand and JB-2 Ramp (unnumbered; HAR-041/LA 104274); Sole site with Building 1249 (HAR-005/LA 99457); and Pritch site with Building 1133 (HAR-007/LA 99633). The fourth re-evaluated site was the Bern site (HAR-021/LA 102577) that had no intact structures.

All of the archaeological sites were considered potentially eligible for the NRHP. The MTSA, Able 51, Mart site, and Sole site were considered potentially eligible under Criteria A, C, and D. They are associated with early Cold War rocket and missile development on HAFB and in the U.S., have intact structures that are architecturally unique, and have the potential to yield further information important to our understanding of early missile, rocket, and drone testing facilities. The Pritch site was considered potentially eligible only under Criteria A and C (Mattson and Tagg 1995:147-148).

North Area, Tularosa Peak, and Boles Wells Survey

In 1995, GMI conducted a cultural resources survey on the HAFB Main Base and Boles Wells Water System Annex (Sale et al. 1996). During this project, the Missile Test Stands Area (HAR-041/LA 104274) site boundaries were expanded to include eight additional features. No new structures were recorded and the existing buildings were not discussed. A brick incinerator (unnumbered) was also documented as Isolated Military Feature 13 (see Table 3). The feature was thought to have been used between 1955 and 1960 to burn fuel from the Aerobee Rocket program (Radian Corporation 1993). As with all isolated occurrences, it was considered ineligible for the NRHP.

Askania Cinetheodolite Tower Research

In 1996, the New Mexico Natural Heritage Program conducted a LRMP-funded research project that focused on the natural and cultural significance of the eight missile theodolite towers located on HAFB and WSMR. Buildings 900, 1133, and 1249 were included in the study. The cultural resources portion of the project focused on establishing an historic context: how and why the towers were developed in southern New Mexico on HAFB and WSMR; how they are associated with the WW II German missile program; and the types of testing conducted at the facilities (Kammer 1996). The towers were also discussed as discrete property types and their relevance to the Cold War arms race was established so NRHP eligibility recommendations could be considered. Kammer (1996:24) suggests that the historical perspective gained through previous research conducted at both WSMR and HAFB had shown the properties meet the requirements of exceptional importance as stated in Criteria Consideration G. Their significance lies in their contributions to the Cold War arms race.

Missile Test Stands Area Mapping

In 1997, GMI archaeologists updated the site map and records for the MTSA (HAR-041/LA 104274) (Sale 1997). Features located after the site was originally documented, and new boundaries, were added to the existing site map. A number of original features never received numbers, and groups of numbers were missing from the original property list (such as 1-6, 8-17), so new and unnumbered features received numerical assignments to fill in the gaps. The project resulted in an undated large scale site map, descriptive feature list (174 features were identified), and Laboratory of Anthropology site form. Drawings were completed for complex features and existing photographic documentation was supplemented. The project did not include further documentation of extant buildings. Sale (1997) recommended that the site is eligible for the NRHP, as opposed to potentially eligible as previously determined, under Criteria A, B, C, and D based on its association with important historical events relating to the Cold War and early Air Force history.

Guided Missiles at Holloman Air Force Base Research

That same year, Weitze (1997) conducted oral interviews and archival research focused on approximately 42 early missile testing programs at HAFB from 1947 through the 1960s. Included in this study were discussions of biological and chemical warfare and the contribution of German scientists to early missile development. Instrumentation development, as it related to the missile programs, was also investigated. During the course of the study, historical data was uncovered for a number of facilities described in this report including the development, construction, and use of the MTSA (Buildings 1116, 1139, 1142, JB-2 Ramp, and Test Stand) and the three missile theodolite towers (Buildings 900, 1133, and 1249). Much of this background data is used in the current report.

CHAPTER 3

THEORETICAL CONSIDERATIONS AND METHODS

THEORETICAL CONSIDERATIONS

The theoretical considerations used to determine the scope of evaluations for buildings and structures on HAFB varied between the WW II and late 1940s properties that are currently 50 years old and those younger facilities constructed after 1947. Although the actual field assessments of facilities were conducted the same way regardless of age, determining historic significance (i.e., whether a property is NRHP eligible) is dependent on the 50 year mark.

Determining Significance

The National Park Service (NPS) considers a resource to be NRHP eligible, or an historic property, when it possesses *historic significance* and *integrity*. More important, ". . . properties must be fifty years of age or more to be considered historic places" (NPS 1981a:1). Significance is determined through four criteria established for the NRHP (36 CFR 60.4): (1) association with historic events or activities (Criterion A); (2) association with important persons (Criterion B); (3) distinctive design or physical characteristics (Criterion C); or (4) potential to provide important information about prehistory or history (Criterion D). Integrity is measured through historic qualities including location, design, setting, materials, workmanship, feeling, and association. Properties must also be significant when evaluated in relationship to major trends of history in their community, state, or nation (NPS 1981a:1). A building, such as a WW II hangar, is considered a cultural resource but it may or may not be an historic property as defined by the NHPA (Rhodes and Green 1995:116).

Certain kinds of resources that are not usually considered eligible for listing on the NRHP can be eligible if they meet special requirements called Criteria Considerations. Criteria Consideration G considers exceptional properties, which are those achieving significance within the past 50 years (NPS 1981c:25). As a general rule, properties that have achieved significance within the last 50 years are not considered eligible for the NRHP because the register is "a compilation of the Nation's *historic* resources . . ." (NPS 1981b:3). It was recognized by the NPS that 50 years was obviously not the only length of time that defined history. Fifty years is a general estimate of the time needed to develop historical perspective and to ensure professional evaluation of a property in an historic context is feasible. This consideration prevents the listing of properties of passing contemporary interest and ensures that the NRHP is a list of truly historic places. For this reason, properties less than 50 years old can be considered significant ". . . only if they are of 'exceptional importance,' or if they are integral parts of districts that are eligible . . ." (NPS 1981b:3, 1981c:25). The term "exceptional" is not defined by the NPS but is understood to include properties that may:

1. reflect the extraordinary impact of a political or social event;
2. be so fragile that survivors of any age are unusual;
3. be the function of the relative age of a community and its perceptions of old and new;
4. have developmental or design value recognized as historically significant by the architectural or engineering profession; or
5. reflect a range of resources for which a community has an unusually strong associative attachment (NPS 1981b:3).

The documentation of HAFB facilities constructed prior to 1948 was considered part of the base-wide inventory for cultural resources based on Section 110 of the NHPA and Air Force Instruction 32-7065. Evaluating the facilities for NRHP eligibility was conducted using the four criteria for eligibility posed by the NPS. The issue of evaluating post-1947 facilities was not as clear, and focused on determining which types of Cold War properties could be considered of exceptional value as defined by Criteria Consideration G.

Department of Defense View

World War II

The DoD has sponsored a number of nationwide historic context studies for the WW II era, including two that focus on the documentation and evaluation of buildings. Garner (1993) provides a broad overview of temporary buildings in *World War II Temporary Military Buildings: A Brief History of the Architecture and Planning of Cantonments and Training Stations in the United States*, and semipermanent and permanent buildings are discussed in *Historic Context for Department of Defense World War II Permanent Construction* (Whelan et al. 1997).

In 1986, the DoD entered a programmatic memorandum of agreement (MOA) with the Advisory Council on Historic Preservation and the National Conference of SHPOs to prepare a history and archival documentation of WW II temporary buildings on U.S. military installations. This MOA was amended in 1990, and its purpose was to meet the DoD's responsibilities for these buildings under the NHPA in advance of their being demolished as directed by the Military Construction Authorization Bill of 1983 (Public Law 97-321).

To honor this MOA, the DoD coordinated a study of temporary buildings on DoD installations throughout the country, in partial fulfillment of Section 106 of the NHPA which requires that the historical significance of the buildings be documented and assessed before demolition. Tri-Services Cultural Resources Research Center, U.S. Army Construction Engineering Research Laboratories (USACERL) conducted the study, which described the principal types of WW II temporary buildings, documented their approximate numbers and locations, and provided an historic context to support DoD's future assessments of these resources (Flora 1992; Garner 1993).

Over 26,000 temporary buildings were thought to remain on bases at the time of the study. Garner (1993:82-85) did not discuss evaluation or preservation of individual buildings other than to suggest that conventional refurbishment and maintenance should be considered over demolition. He also suggested that simple techniques such as insulation, internal sheathing, and periodic painting could eliminate the inefficiency of the original temporary structures and provided a recommendation that ". . . preserving usable clusters of buildings in their original cantonment layout would, where feasible, be a desirable approach to designating a 'living monument' to the U.S. World War II effort" (Garner 1993:85).

To compliment the temporary building study and provide an understanding of the full range of facility types from WW II, R. Christopher Goodwin and Associates examined the historical, architectural, and technological development of semipermanent and permanent buildings constructed on DoD bases during the war (Whelan et al. 1197). They recognized that identifying the purpose of an installation was essential in determining which properties represent the historic context and can be considered significant. A three level hierarchy was adopted, dividing DoD installations by function (Command, Industrial, and Special Projects), with subgroups consisting of the installation's military mission/purpose within that function (Table 4). The various types of installations encompassed buildings and structures, necessary to support their mission, that are classified by use and include: administration; communication; defense; education; health care; industrial; infrastructure; personnel support; research, development, and testing; residential; storage; and transportation (Whelan et al. 1997:14-15).

Table 4
World War II Property Types

I. Command (installations that directly supported training, operations and logistics)
- -Air Fields and Air Stations
- -Coastal Defense and Combat Operations
- -Depots (non-ordnance) and Embarkation Ports
- -Medical Facilities
- -Navy Bases and Stations
- -Navy Yards
- -Research, Development, and Testing
- -Strategic Communications
- -Training

II. Industrial (installations operated to produce war materiel)
- -Aircraft Production
- -Ammunition Depots
- -Artillery/Artillery Parts Production Plants/Arsenals
- -Chemical Warfare Service Facilities
- -Explosive Production Works
- -Large Ammunition Assembly Plants
- -Small Arms Ammunition Plants
- -Tank Arsenals

III. Special Projects (defined by the War Department)
- -Manhattan Engineering District (Manhattan Project)
- -Pentagon

Preliminary analysis of DoD real property data indicated that approximately 55,000 buildings currently listed as semipermanent and permanent existed on military bases throughout the country, including 5,310 administered by the USAF. As with the temporary building study, site specific archival and field investigations were not conducted. Seven installations with large inventories of WW II permanently constructed buildings were chosen as test cases for the evaluation of properties (Whelan et al. 1997:2-7). It was determined that “[t]he framework established by the historic context for World War II permanent construction focuses on the mission of an installation in assessing its significance, as well as the significance of its component resources” and these resources “. . . first should be evaluated as potential districts” (Whelan et al. 1997:240). For individual properties to be considered significant, they “. . . must possess important, specific association with the war and sufficient integrity to convey the World War II period of significance" (Whelan et al. 1997:256). The property should possess one of the following criteria:

1. clearly and explicitly reflect the important mission of the installation;

2. be regarded as emblematic of the installation or of an aspect of the World War II military mission; or

3. represent particularly significant examples of a type or method of construction or the important work of a significant architect (Whelan et al. 1997:256).

HAFB, or AAAF, was constructed during the massive mobilization effort required for WW II. Because Garner's study focused on DoD installations with 100 or more WW II temporary structures and Whelan et al. only looked at a few bases with large numbers of permanent buildings, HAFB was not specifically addressed. In addition, those WW II buildings that remain on the base are scattered and, as such, need to be assessed on an individual basis, not as a group or district. Because of the extensive modification to the Cantonment Area in the years following WW II, there is no remaining feeling of character from that time period. For that reason, under these WW II contexts, only those facilities which possess one of the four criteria necessary to attain NRHP eligibility can be identified as significant (NPS 1991c). The NRHP criteria "recognize different types of values embodied in . . . buildings . . ." (NPS 1991c:17). Of the four criteria, only one is applicable to HAFB buildings. Under Criterion C, "properties may be eligible for the National Register if they embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction" (NPS 1991c:17).

It may be argued that, because WW II is a significant event, Criterion A, which addresses properties associated with ". . . one or more events important in the defined historic context" (NPS 1991c:12), might also apply. This criterion is not considered for HAFB's WW II facilities because "the mere association with historic events or trends is not enough, in and of itself, to qualify [a building] under Criterion A: the property's specific association must be considered important as well" (NPS 1991c:12). There is no question that AAAF made a significant contribution to the town of Alamogordo, and aircrew trained at the base contributed to the war effort, but the remaining buildings are not considered to represent that significant part of HAFB or WW II.

Cold War

In 1991, the DoD began the process of addressing post-WW II resources in response to the Congressional mandate to "inventory, protect, and conserve" the heritage of DoD during the Cold War (USAF 1994: iii). The DoD recognized that within its installations throughout the world there was a wealth of unique and irreplaceable resources that represented one of the most important national events since WW II. Waiting 50 years before engaging in historic preservation activities would result in the loss of many of these resources (USAF 1994:62). DoD cultural resources managers were operating under existing laws, regulations, and practices during the evaluation process for historic resources. Unfortunately, there was a common misconception that the requirements of the NHPA applied only to properties at least 50 years old or more, and Cold War resources were being lost because they were not being considered (USAF 1994:14).

The DoD addressed Cold War property management and preservation issues with the broad understanding that military properties might be valuable because of their technological associations or connection with the military mission. They recognized that not all Cold War properties should be protected under the NHPA. To determine which properties held historical value, they needed to be broadly catalogued according to property type and function. Within this category, a building or structure could be evaluated based on: (1) how central it was to the military mission; (2) how many were developed or constructed; (3) how much the DoD invested in it; (4) whether it retains historical integrity, and; (5) whether similar or equivalent facilities exist elsewhere. One important consideration in making these determinations is "continuity of use." Physical properties associated with military activities seldom remain untouched over time. Continuity of use refers to facilities whose essential functions remain the same regardless of changes and modifications to its appearance. Also, the significance of a Cold War resource may lie in its current, or most recent, use rather than in its original use (USAF 1994:16-19).

If, after research is completed, a property does not merit protection, its purpose, design, and use will have been documented before it is modified for other uses or destroyed. Should a property be determined significant based on its physical condition or intrinsic historical value, preservation treatment methods must be considered. Options for management include preservation in place, nondestructive reuse, and further documentation (USAF 1994:19-21).

In 1993, the USAF created its *Interim Guidance,* which molded the NRHP evaluation criteria to meet the Cold War issue and included an initial list of Cold War Historic Property types in which to categorize facilities. The specific criteria of historic significance for Cold War properties focus on buildings, structures, objects, sites, or districts that:

1. possess exceptional value or quality in illustrating the Cold War heritage of the United States and that possess a high degree of integrity of location, design, setting, materials, workmanship, feeling and association; and

2. that are directly associated with events that have made a significant contribution to, are directly identified with, or outstandingly represent the broad national pattern of United States Cold War history and from which an understanding and appreciation of those patterns may be gained; or

3. that are associated directly and importantly with the lives of persons *nationally significant* in the Cold War history of the United States; or

4. that represent some great idea or ideal of the American people (e.g., "Peace through Strength"); or

5. that embody the distinguishing characteristics of an architectural, engineering, technological, or scientific type specimen *exceptionally valuable* for a study of the period, style, method, or technique of construction, or that represent a significant, distinctive and *exceptional* entity whose components may lack individual distinction (USAF 1994:66).

The USAF proposed an initial set of property types and Air Force examples that met the criteria of exceptional significance and eligibility for the NRHP (Table 5; USAF 1994:66-67). They also provided a list of resources not considered exceptionally significant and thus ineligible for the NRHP. This list included many real property types that are typically subject to Section 106 consultation on older, pre-WW II bases and include family housing (Capehart, Wherry, etc.), Bachelor Officers' Quarters (BOQ), base exchanges, administrative buildings, garages and motor pools, maintenance shops, sewage treatment plants, and so forth. Hangars might fall within this category but would need to be evaluated before the determination of eligibility could be made. The USAF plan was to ". . . focus specifically on operational missions and equipment of unmistakable national importance and a *direct*, not merely temporal, Cold War relationship." This focus was based on the need to act quickly with limited funds and knowing that the ". . . vast support complex that lay behind the 'front-line' combat or intelligence units will, in due time, be inventoried for historic significance" (USAF 1994:69).

ACC personnel took the next logical step in developing a management strategy and, under the LRMP, initiated a Cold War property inventory at its bases to test and refine the guidelines set forth in the *Interim Guidance* (Lewis et al. 1995). The focus of the reconnaissance was to document representative types of buildings and structures on each base, then record in more detail and provide preliminary NRHP evaluations for those resources determined to have an important association with the role each installation played within the Cold War context. From these assessments, the USAF property type list was supplemented, creating more extensive subgroups under the original five major group headings (see Table 5; Lewis et al. 1995:113-114).

In determining NRHP evaluation criteria for the Cold War properties, Lewis et al. (1995:123) expanded on the USAF themes by citing Joseph Murphey's (1993) perspective on the issue. Murphey suggested that until the appropriate temporal perspective is achieved, properties of exceptional Cold War significance should be those that will provide today's generation with obvious tangible manifestations for the interpretation of the ideological differences extant in the Cold War era, i.e., U.S.-Soviet relations.

Table 5
USAF Cold War Property Types

Property Type	Example
Operational and Support Installations:	Air Force bases, including command centers Missile stations Launch complexes
Combat Weapons Systems and Combat Support Systems:	Missiles Aircraft (Fixed Wing and Rotary) Ground vehicles and equipment
Training Facilities:	Warfighting, combat support, and intelligence schools Launch complexes Combat training ranges Impact areas: targets POW (Prisoner of War) training camps
Material Development Facilities:	Research laboratories Manufacturing sites Test sites Proving grounds
Intelligence Facilities:	Radar sites Listening posts

An example would be the Berlin Wall, which is a property of exceptional significance as the ideal symbol of the clash of opposing ideologies (see Grathwol and Moorhus 1994 for a good discussion of the Berlin Wall). Lewis et al. (1995:123-124) also noted two concerns in the evaluation of highly scientific and technological resources: the need to preserve the physical reminders of U.S. scientific legacy and the continued need to upgrade scientific and technical research facilities that are still in operation.

Finally, in addition to using the USAF *Interim Guidance* for prioritizing resource groups and property types, Lewis et al. (1995:130-131) considered Murphey's (1993) slightly different technique. Murphey identified seven categories and ranked them in order of importance.

1. Research and Development. These properties reveal the very nature of the Cold War that produced the vast military-industrial complex devoted to technological solutions to an ideological confrontation. The activities that took place within these properties led directly to technological hardware that could affect the strategic balance of power.

2. C^3I Complexes and Systems. The key to survival before, during, and after a nuclear first strike was maintaining command, control, communications, and intelligence (C^3I). These properties represent the extent of the mistrust and suspicion of Soviet intentions.
3. Strategic Weapon Systems and Support. Planned and deployed weapons systems and their direct support structures specifically designed to combat Soviet forces were used as bargaining chips in arms control negotiations and formed the basis for the balance of power.

4. Strategic Materiel Production Facilities. The vast infrastructure of industrial facilities was used to produce the high technology hardware which gave credence to U.S. Cold War resolve.

5. Operational Support Facilities. Depots, storage warehouses, maintenance docks and hangars, etc., provided operational mission support and movement of men and materiel.

6. Training Facilities. These properties were used to train personnel for Cold War missions.

7. Social Support Facilities. Dormitories, theaters, chapels, exchanges, etc., provided the necessary support services for personnel.

Murphey's rationale was that the first three categories are most likely to exhibit exceptional significance due to their direct influence in Cold War policy making, whereas the final four are less likely to be directly involved. However, any property of any type can unexpectedly illustrate the symbolism of the ideological and economic battle of the superpowers in an exceptionally significant manner (Lewis et al. 1995:131).

Holloman Air Force Base View

HAFB has over 1,000 buildings on the real property list, of which about half are housing units. Most of these buildings were constructed during some part of the Cold War, while only a small number date from either the WW II or the post-1989 eras. These buildings are continually being upgraded to support the base mission and many of the older facilities are being demolished to make room for modern buildings. Work requests documenting these projects are processed daily through the 49th Civil Engineer Squadron Environmental Flight (49 CES/CEV), and cultural resources comments are solicited regarding historic significance. For this reason, and because of the Cold War initiatives described above, a base-wide inventory was initiated to determine the historic value of facilities and structures constructed prior to 1990.

In addition to the documentation of all WW II facilities, all buildings constructed prior to the end of the Cold War, with the exception at this time of housing units, will receive an initial evaluation. Although this does not follow the USAF viewpoint of focusing on those functional types that were directly involved in Cold War activities, it was justified by two basic concepts. First, because of the changing mission of a base such as HAFB, buildings are continually upgraded and modified, and often their functions change. What started out as a storage warehouse, which would not be considered exceptional, might have later become a missile assembly building in support of an important test vehicle program. This information is not always readily available in real property records and might only be found during the initial evaluation process while delving into historic files and construction/modification blueprints. Because of this possibility, the second justification is that any property of any type can unexpectedly illustrate HAFB's role in the Cold War in an exceptionally significant manner.

The decision was also partially based on the author's experience as an archaeologist. All archaeological sites, regardless of whether they are a sparse artifact scatter or 50 room pueblo, a trash dump or intact cabin, receive basic documentation before a determination of eligibility can be made. This ensures that if the site is destroyed during a construction project, information will be available to assist future archaeologists in their interpretation of the prehistory or history of the area. Whether the artifact scatter has the potential to yield further information or not, the documentation of its presence in a given place is a record of the past.

Based on these concepts, all buildings and structures other than housing units, regardless of the fact that they might not be in the exceptional category by USAF standards, will receive the same level of initial documentation as those of unquestionable significance. To achieve this goal, the assessment began with evaluations of facilities based on their construction dates rather than their historic or current functions. The first two base-wide architectural assessment projects focused on facilities built during a specific temporal period, with some later-constructed buildings included because of their association with specific Cold War programs or high potential to be exceptional under on the USAF guidelines. The first architectural project, presented in this report, evaluated all 1940s facilities and a number of 1950s and 1960s facilities. The second project focused on those facilities constructed between 1950 and 1960 that had not already been evaluated (Fulton and Cooper 1996).

Housing units, such as Capehart and Wherry buildings, were originally included in the scopes of both architectural assessment projects. The original plan was to take one or two examples of each group of like buildings and evaluate them as a representative sample. It was determined early in the fieldwork that this method would not work because of the vast history behind the variety of housing types and because of the difficulty in discerning the true feeling of the architecture of a type of housing unit by evaluating only one. No reliable method of determining the best representation of each type could be found because of later modifications to the facilities. For this reason, large groups of housing units were eliminated from the sample, with the intent of investigating them after the bulk of other types of facilities were assessed.

The properties assessed here, therefore, represent the continued effort to take an initial look at the physical evidence of HAFB's role in WW II and the early Cold War. The documented facilities are all either 50 years old or fall within one of the USAF categories for potentially exceptional property types. The theoretical considerations set forth by the USAF and ACC provide the initial guidance for evaluating these properties and their significance at both the local (HAFB) and national levels.

METHODS

HABS/HAER Level IV documentation was completed for each of the 34 facilities discussed in this report. This level of HABS/HAER documentation is the first step in evaluating the significance of buildings and structures on HAFB. It consists of a completed field form which, unlike the other three levels of HABS/HAER documentation, is rarely considered adequate for the HABS/HAER Library of Congress collection. It is, instead, undertaken to identify historic resources in a given area prior to additional, more comprehensive documentation (Fulton and Cooper 1996:13). Those facilities which retain little or no historic integrity will receive no further work, while those recommended eligible or potentially eligible for the NRHP during this initial evaluation will need further documentation before they can be substantially modified or demolished.

In 1995, Fulton and Cooper (1996) developed field methods and a HABS/HAER Level IV survey form to facilitate consistent documentation of HAFB facilities. The field methods included review of real property records and engineering/construction drawings and site visits for each facility. In addition, brief histories of the facilities were developed using previous HAFB research and interviews with base personnel. The form was modeled after the HABS/HAER Level IV form accepted by the New Mexico SHPO, and provides the initial documentation of a given property using NRHP criteria to make a preliminary significance evaluation (Appendix B). It includes sections on the architecture, historic and current use, original architectural and structural features, current features if different from the original, brief statement of historic significance, association with other facilities, and additional comments and maintenance recommendations. The form also includes a section on the assessment of historic integrity, a current photograph, and an AutoCAD plan view based on the earliest construction drawing available for the property.

At the end of the investigation, a working folder was prepared for each building or structure. This folder includes copies of the Real Property Accountable Record-Buildings form, both the earliest and the most recent engineering blueprint, and the completed HAFB field survey form. These folders are on file at the 49 CES/CEV office.

Real Property Accountable Records

The first step in the evaluation of HAFB facilities was the review of real property records. The Real Property Office at HAFB retains files on all facilities, with a few exceptions, that are currently located on the base. Within each file is the Real Property Accountable Record-Building form (Air Force Form 1430, 15 June 1956 version), which provides the construction completion date, construction type (i.e., roof, wall, foundation, and floor material types), original and subsequent building functions, and major alterations. Related correspondence, equipment change-outs, and miscellaneous information and drawings are also in each file. These records provide an invaluable source of baseline data for each property (Fulton and Cooper 1996:7). In addition, the Real Property Office creates a USAF Real Property Inventory Detail List each quarter of a fiscal year with the updated status of each facility. This list contains much of the information from the building file but also continually updates the current use of a facility.

Civil Engineer Facility Drawings

The second step was a review of existing facility working drawings. Facility drawings and blueprints are housed in the drawings vault of the Drafting/Survey Element of the 49 CES Engineering Flight. Numbers and types of drawings vary for each facility and may include original (as-built) and/or later, more recent, modification/rehabilitation blueprints. In some cases, over 100 blueprints were available for review for one facility, and in other cases no drawings at all existed for a facility. An index of all drawings available for each building was prepared. Each index was annotated, noting pertinent details. Both the earliest and most recent architectural and structural drawings were copied and used during field visits to determine how each building has been altered since its original construction (Fulton and Cooper 1996:7). Some additional drawings were available through the base organization responsible for managing a building. For example, many historic drawings and blueprints are on file at the High Speed Test Track administrative office.

Site Survey

Using real property records, construction drawings, and the blueprint index, a site visit was made to each facility to determine its degree of alteration since the original construction completion date. The construction completion date was determined from the as-built date (actual) stamped in the revision block of each original construction drawing. If original drawings were not located, or if the date was not properly stamped, a construction completion date (estimate) was determined using the Real Property Accountable Record-Buildings forms (Fulton and Cooper 1996:7).

The site survey documented the current placement of all exterior door and window openings, interior and exterior finishes, floor plan, layout, and room use. Any alterations to the most recent blueprints were noted. These marked-up recent blueprints were then compared to the earliest available drawing for each building. An assessment was made concerning the percentage of original design, materials, and workmanship remaining.

One photograph of each building's principal elevation was taken, if possible. Routine maintenance was suggested for each building (Fulton and Cooper 1996:7).

Historic Context

The final step in the documentation process included determining the historic context of the buildings and facilities. The NPS (1991a:49) defines historic context as the relationship between the properties and ". . . important themes in prehistory or history." This context must include information about the surrounding community or larger geographical area and must explain the importance of the properties by showing how they are unique, outstanding, or strongly representative of an important trend or theme and rooted in place and time (Fulton and Cooper 1996:7-8). Historic use of the base during WW II and the early Cold War, and of most of the Cold War facilities, has been researched during previous LRMP projects (see Mattson and Tagg 1995; Vandiver 1996; Weitze 1997). Additional information was recovered from microfilm acquired from the Maxwell AFB Museum in Alabama and through personnel interviews at the time of the building inspections. Because background histories of many of the facilities and WW II and Cold War contexts have already been developed in ACC and HAFB LRMP reports written as source documents, it would have been a duplication of effort to research again what had already been documented in these reports. These secondary sources, rather than the primary sources, were cited extensively throughout this report.

CHAPTER 4

HISTORIC CONTEXT

For all properties, whether they are older or younger than 50 years, determining significance is partially based on their ". . . relationship to major trends of history in their community, state, or nation" (NPS 1991a:1). To weigh this relationship, ". . . information about historic properties and trends is organized by theme, place, and time, into *historic context* that can be used to weigh the historic significance and integrity of a property" (NPS 1991a:1). The DoD has recently made great strides in developing WW II and Cold War contexts and specifications for evaluation resources from these eras (see Garner 1993; Lewis et al. 1995; USAF 1994; Whelan et al. 1997). These and other studies were useful in developing the historic context necessary for addressing the significance of the WW II and Cold War facilities assessed during the current project. The national context is discussed first, followed by the trends at HAFB as they relate to that larger picture. The importance of tying the base-specific analysis of facilities into the broader national context is to ensure an assessment method consistent with projects conducted at other DoD installations.

NATIONAL CONTEXT

The national historic context covers the broad periods of WW II and the Cold War, which have been divided into the first eight categories listed below (Futrell 1955; Lewis et al. 1995; Sellers et al. 1976). The current era was taken from Boyne (1993). What follows is an attempt to provide a view of the events of the "wars," as well as what effect these events had on the types of facilities constructed on USAF bases in the continental U.S.

(CONUS). Both conflicts unquestionably controlled the establishment and/or build-up of military installations across the U.S. and determined the types of facilities constructed.

WW II:

1. Outbreak: Augmentation of Facilities (1939-1940)
2. Disaster: Expansion of Facilities for Hemispheric Defense (1940-1941)
3. Intervention: Expansion of AAF Facilities (1942-1943)
4. Victory in Sight and the Atomic Age: Consolidation and Disposition of Facilities (1943-1945)

Cold War:

5. Inception of the Cold War (July 1945-January 1953)
6. Nuclear Technology Escalation (January 1953-November 1963)
7. Détente (November 1963-January 1981)
8. A New Deterrence (January 1981-November 1989)

The Current Era:

9. Transition into the Future (November 1989-present)

Secondary sources about WW II and the Cold War are abundant, but several of these were instrumental in the development of the following context. In 1942, President Franklin D. Roosevelt ordered each war agency to prepare an accurate account of the war experience while it was still fresh in the minds of the participants (Kohn 1955: iii). This resulted in the publication of a series of books entitled *The Army Air Forces in World War II* (the so-called "Blue Books"), a history covering all aspects of the air war, including one volume dedicated to the home front (Craven and Cates 1955). The historic context for WW II has been taken from this publication because it provides an in-depth look at the massive development of bases in the U.S. (Futrell 1955). The big picture view of the war abroad, taken from a variety of sources, is interspersed with the home front effort so the full picture of WW II can be understood. Futrell (1955) divided WW II into the four categories listed above, which have been modified for this report to incorporate the broader view of the war from categories set forth by Sellers et al. (1976). The DoD WW II permanent construction volume (Whelan et al. 1997) also provides an excellent historic context, but unfortunately it was not available at the time the current report was written.

For the purpose of the HQ ACC Cold War study, an historic context, described previously (see Previous Research), was developed to aid in the evaluation of the material culture on individual bases (Lewis et al. 1995:24). Unlike the WW II context, the Cold War discussion focuses more on world events and less on the impact of the conflict on the development of facilities on the installation, because the latter information was not readily available.

The facilities addressed in this study were constructed within four of the eight temporal categories listed above, although all of the post-1942 contexts are potentially valuable in the assessment process. While the architectural assessment focuses on the original use of a structure at its construction, modifications through time for additional functions must also be addressed. Base missions, and thus facility functions, change through time. Buildings within the Cantonment Area, in particular, have undergone many modifications as these functional changes occurred. Buildings, especially those built in WW II, span all historic periods from their construction date to the present time, and may have had different uses in each. When determining significance, both structural integrity and building function must be addressed. The significance of a building may not be a result of its construction type but rather due to a later function. For instance, the WW II base theater at AAAF was adapted in the early Cold War as a missile assembly building (Weitze 1997:45). In most cases, a theater would not be significant, but a missile assembly building might be due to its association with an important test vehicle program.

World War II (1939–1945)

General Henry "Hap" Arnold, chief of the Army Air Corps, stated, "An Air Force is a balanced compound of three essential ingredients—*airplanes, combat and maintenance* *crews, and air bases*" (Futrell 1955:119). With these ingredients, the U.S. Army Air Forces (the Air Corps at the beginning of the war) made a major contribution to the allied victory in WW II. In a combined bomber offensive, a coordinated round-the-clock strategic campaign between the Royal Air Force (RAF) and the USAAF struck German submarine pens, aircraft production and related industries, and oil facilities. Later in the war, Allied air forces concentrated on attacking Germany's industrial heartland, especially transportation targets, to demoralize the enemy, disrupt production, prevent reinforcements and supplies from reaching battle lines, and wreck the Nazi war economy. Allied domination of the air led inevitably to Germany's, and ultimately to Japan's, unconditional surrender (Neufeld 1995:3). WW II is often characterized as a war of resources, and in the beginning it was a race to mobilize the men and materiel needed to meet the crisis. On the home front, the mass development of USAAF base facilities represented a major part of the national war effort in terms of money expended, materials used, and man hours employed. While no single facility made the difference in the result of the war of resources, the cumulative effect of the effort was a decisive factor in the allied victory (Futrell 1955:121; Whelan et al. 1997:1).

Futrell (1955:121) described the functions of USAAF facilities:

> Each base, regardless of whether it was used for training or for combat, thus had to maintain facilities for housing and sustaining its personnel and for performing the air mission. It had to maintain and operate runways, control towers, air communications equipment, weather apparatus, off-base navigational aids, night lighting devices, and synthetic training installations, as well as the extensive shops and warehouses required for the maintenance of aircraft and other equipment. The base also had to supervise subbases, auxiliary fields, and bombing and gunnery ranges.

Within the CONUS, the air bases had to be properly located for continental defense, in addition to being training and service organizations. For the defense mission, the USAAF needed bases and auxiliary airfields in the four possible theaters of war: the northeast, southeast, northwest, and southwest. As a training organization, the USAAF also required bases geographically situated to provide the most favorable weather for year round operations. Meeting these requirements on the scale dictated by the expansion of the air arm between 1939 and 1945 required an extensive program for the development of base facilities. From a total of 17 air bases, 4 air depots, and 6 bombing and gunnery ranges in January 1939, the USAAF expanded to peak totals of 783 main bases, subbases, and auxiliary fields; 12 air depots and 68 specialized depots; and 489 bombing and gunnery ranges by 1943, covering 19,698,993 acres of land (the size of New Hampshire, Vermont, Massachusetts, and Connecticut combined) (Futrell 1955:120-121).

Outbreak: Augmentation of Facilities (1939–1940)

The Nazi occupation of the Rhineland in 1936, Austria in 1938, and the blitzkrieg of Poland in 1939 provided a forewarning of all-out war in Europe that would likely lead to U.S. involvement (Garner 1993:16). As early as 1938, President Roosevelt called for an air force, not ground force, powerful enough to deter Hitler and advised Congress in 1939 that "our existing air forces are so utterly inadequate that they must be immediately strengthened" (Boyne 1993:120; Siefring 1982:32). In direct conflict with Congress and the national view of "who [sic] we were going to fight," the President orchestrated a number of policies to lend support to Allied nations and also prepare the U.S. for the upcoming conflict. In 1939, he repealed the Neutrality Act and replaced it with the "cash and carry" law that allowed warring powers to purchase arms in the U.S. for cash and carry them home in their own ships. In 1941 the Lend-Lease Act was engineered by Roosevelt to provide war materials to the English and French, who had exhausted available funds (Boyne 1993:127-129; Siefring 1982:34).

Recalling WW I experiences when emergency planning, although ultimately effective, came late in the war effort, the Army Quartermaster General began in 1939 to prepare plans for the expansion of existing, and construction of new, military bases (Garner 1993:16). The organization of Air Corps installations in operation at that time was a "hodgepodge of air fields hurriedly developed for training purposes during World War I" (Futrell 1955:121). Although new bases had been built and most of the older bases improved, the number of installations fell far short of the Air Corps' needs in 1939. Both from the point of view of housing and technical facilities the existing training airfields, with few exceptions, were ill equipped for their upcoming missions. The bombing and gunnery ranges available to the Air Corps were also too few in number and small in size for the intensive training necessary (Futrell 1955:121-125). Overall, the U.S. was poorly prepared for the war to come (Garner 1993:13-14).

In January 1939, General Arnold proposed to Congress that money be spent to provide a foundation for a well rounded air defense. Determined to stretch the available funding as far as possible, General Arnold initiated a 'flesh and bones' program which made funds available only for the most urgently needed items. Permanent brick and concrete construction would be used only for technical buildings, while troops would be housed in temporary mobilization-type wooden buildings (Futrell 1955:127). Efforts to secure airfields and bombing and gunnery ranges, which had actually begun in 1936, became national priorities. An effort was also made, in cooperation with the Works Progress Administration and Civil Aeronautics Authority, to build up civilian airports of value to national defense. The process for selecting and constructing training sites moved slowly, and securing land for the fields and ranges was only partially successful (Futrell 1955:128-130). Congress authorized funds to revitalize the Air Corps, and a thorough study was made to determine the best means of using air power for national defense. General George C. Marshall commented that "for the first time a specific mission for the Air Corps has been established" (Siefring 1982:33).

Disaster: Expansion of Facilities for Hemispheric Defense (1940–1941)

By early autumn 1940, most of the European continent and its industrial production was in Nazi hands: in April, Danish independence was eliminated and Norway fell; and in May, the Germans crossed the Belgian and Dutch borders and blitzkreiged across northern France. Nazi submarines and surface raiders were stalking the sea lanes and wave after wave of German bombers were wreaking havoc on English cities. British losses of aircraft, aircrews, and weapons in France and Norway were high (Guinn 1995:9; Siefring 1982:34, 41).

Great Britain and France increased orders of U.S.-manufactured combat aircraft to over 2,000 per month, which made the American aircraft industry the largest producer of aircraft in the world. By September 1940, the U.S. and Britain had started outlining requirements for providing aid to the battered British Isles. General Arnold made an offer to the British Air Staff to allocate one-third of the rapidly expanding pilot training courses in the U.S. to British students (British Flying Training Schools), and by late 1940, the first of five plans for training British aircrews in the U.S. began. The expansion of American and British relations became what would later be called "history's most effective alliance" (Guinn 1995:10; Siefring 1982:34-37).

The continued Nazi success in Europe made it evident that more aircraft and trained aircrews were necessary for national defense and to successfully defend the western hemisphere. In September 1941, the Secretaries of War and of the Navy made a realistic forecast of air requirements to wage a war against Japan and Germany: 239 combat groups, 63,467 aircraft, and 2,164,916 airmen by 1944. The actual number of men used in 1945 was 2,400,000 (Siefring 1982:37).

The deteriorating Allied cause in Europe would not condone a slow moving bureaucratic process in the U.S. war cause, and by 1940, Air Corps personnel strength had been expanded to 54 combat groups, major airfields required to defend the U.S. were under construction, and arrangements had been made to build up civilian airfields for dispersal against attack. The War Department announced that existing military, state, and municipal facilities must be used to the maximum. In addition, new construction would be of a temporary wooden type and the number of hangars and maintenance buildings would be kept to a minimum (Futrell 1955:131).

In February 1941, General Marshall directed the Chief of the Air Corps to increase pilot training to 30,000 and technician training to 100,000 men per year. The Air Corps objective was set at 84 combat groups and 7,799 aircraft. Funds for 20 new flying training fields and one gunnery station were approved. Problems arose with finding acceptable sites, which were becoming scarce, for the new fields. By June 1941, there were no alternatives except to locate new stations in more northerly regions with excessive rainfall or the southwestern desert country where heat, dust, and insufficient civilian housing would be encountered. All of the new fields were eventually sited, but only after the West Coast Training Center's boundaries were extended to include the mesa country of New Mexico and west Texas. The War Department authorized the purchase of real estate instead of the usual leasing process, and most of the new fields were operational by early 1942 (Futrell 1955:139-140).

New air stations were needed to facilitate the growth, and by June 1940, locations for new flying training fields and gunnery ranges had been investigated. By March 1941, funds had been allocated to build up existing airports and develop fields in the nation's four defense areas. The Quartermaster Corps started lease negotiations for the new locations, but because they were overtasked by this and the burden of construction, the U.S. Army Corps of Engineers (COE) replaced them in all tasks that had to do with Air Corps construction projects (Futrell 1955:133-137).

Acquisition of the millions of acres required for the general ranges, designed for aerial gunnery and actual bombing practice, was difficult. Most of the acreage was public domain, but there were scattered grazing, homestead, and mining claims that had to be assessed and purchased. In cases of protests from land holders, such as stockmen, the government finally resorted to condemnation of the leaseholds. Ranges in Nevada, Oregon, and Utah were available in late 1941, and three other general ranges were acquired late in 1941 and exploited in 1942. One of the latter ranges was near Alamogordo, New Mexico (Futrell 1955: 142-143).

The internal organization of the Air Corps reflected the growing influence of the military. In June 1941, the Air Corps became the Army Air Forces with General Arnold as its commander. Four separate Air Forces were created, numbered First through Fourth (Goss 1955a:21,71; Siefring 1977:42). The major responsibilities of this continental air force during the war years were air defense and training. The First and Fourth Air Forces were assigned to the Eastern and Western Defense, respectively, while the Second and Third Air Forces concentrated primarily on unit training. The emphasis on training fell originally on the Operational Training Unit (OTU) programs, through which graduates of training schools were welded into combat units. The Second Air Force emphasized heavy bombardment unit training, while the Third Air Force stressed fighter aviation and light and medium bombardment (Goss 1955b:72-74). After WW II began, the numbered Air Forces increased to support the various overseas theaters of operation; these included the Fifth through the Fifteenth and the Twentieth Air Forces (Siefring 1977:42).

By 7 December 1941, the USAAF had developed 114 bases and subbases in the CONUS and 47 additional airfields were projected or under construction. With facilities of all types under use by the USAAF, 293 separate installations were either owned or leased. Over the course of two years, ". . . the work had been done with sufficient expedition to make possible the extraordinary expansion of all USAAF activities that would follow hard upon Pearl Harbor" (Futrell 1955:145).

Intervention: Expansion of AAF Facilities (1942–1943)

On the other side of the world the Japanese planned a sneak attack against the U.S. facilities at Pearl Harbor. The Japanese empire had already exploited Korea ruthlessly, pillaged large areas of China, and would soon conquer Indochina, the Philippines, the Dutch East Indies, and threaten Australia. Germany had already conquered Poland, Norway, Holland, Denmark, Belgium, Luxembourg, France, Yugoslavia, and Greece. It had apparently defeated Russia, although the battle of Stalingrad in late 1942 started to turn the tide, and had a stranglehold on the British in Africa. It seemed possible that there could be a linking of the Axis forces of Germany and Japan in India (Boyne 1993:143; Sellers et al. 1976:358-359).

On 7 December 1941, now known as the Day of Infamy, the Japanese launched an attack on the U.S. fleet anchored in Pearl Harbor, which directly triggered American involvement in WW II. Immediately after the attack the U.S. declared war on Japan, and three days later Germany and Italy declared war on the U.S. (Whelan et al. 1997:31).

USAAF losses at Pearl Harbor were high, and American units in the Philippines went on alert immediately after the attack but could do little to stem the tide of the Japanese. Overwhelming Japanese forces finally captured the Philippines and Corregidor (Boyne 1993:144-146). Even with the defeats suffered by the U.S. in the early months of the war, America was not beaten. On 18 April 1942, Lt. Col. Jimmy Doolittle led 16 B-25 bombers in a successful raid against Tokyo, and later that year there were U.S. victories at Midway (June) and Guadalcanal (August-February) (Boyne 1993:147; Sellers et al. 1976:358-359).

Also in 1942, a top secret program began in the U.S. that would eventually bring an end to the war and change the world. In August of 1939, Albert Einstein wrote a letter to President Roosevelt stating that nuclear research indicated powerful bombs based on uranium might soon be possible, secret work with uranium was being conducted in Nazi Germany, and similar American work should be accelerated. By the end of 1942, the Manhattan Engineer District, later simplified to the Manhattan Project, was established at Site Y, Los Alamos, New Mexico, to develop and build an atomic bomb. The project was under the direction of physicist J. Robert Oppenheimer, a former student at the Los Alamos Ranch School for Boys where the atomic laboratory was now located. President Roosevelt backed the project without the knowledge of Congress or the electorate, disguising more than two billion dollars in funding in the federal budget (Thomas and Witts 1977:7-8).

The European air offensive started slowly. The USAAF strategic concept was based on precision daylight bombing using the B-17 Flying Fortress, the newer B-24 Liberator, and the Norden bombsight (Boyne 1993:151). The Eighth Air Force began strengthening bomber squadrons in England in February 1942, flew its first sustained air assault against Luftwaffe installations in Holland in July 1942, and had 4,000 airplanes on the continent by December 1943 (Siefring 1982:42, 147-150). The first success of high level precision bombing came in August 1942, but the Eighth Air Force's strength built up very slowly because of the support given to General Douglas MacArthur's Pacific campaign and Operation Torch, the invasion of North Africa (Boyne 1993:153; Siefring 1982:48-50).

The Japanese attack on 7 December 1941 and the U.S. declaration of war on December 8 brought about the quick multiplication of the numbers of USAAF airfields and forced new attention to achieving quicker and cheaper construction. The USAAF had to take over new airfields to disperse its units, for their own protection against possible enemy attacks and the defense of the continental sea frontiers, and provide the installations needed for immediate mobilization of an air force of tremendously increased size. The immensity of this effort led to a decentralization in which agencies in the field, and not the USAAF Headquarters, had to assume responsibility for determining what facilities they needed (Futrell 1955:145).

Problems with passive defense rose to the forefront and thus the implementation of protective devices such as revetments (defensive barricades against explosions), dispersal, and camouflage became standard operating procedure against attack. General Arnold directed that all aircraft west of the Rocky Mountains and on the Atlantic coast be protected or dispersed. All new bases built within 350 miles of the coasts and within 300 miles of the Gulf would be given a dispersed layout. The War Department gave the Western Defense Command and the Eastern Theater of Operations the power to bypass normal channels to get emergency construction completed. By 26 December 1941, the COE had started protective construction projects on 81 airfield projects along the Pacific Coast and 30 bases along the Atlantic. In early 1942, however, these emergency measures ended and by the end of the year, with some overseas experience, the USAAF returned to more compact and conventional airfield designs (Futrell 1955:145-146).

In early 1942, General Arnold believed that the war would be fought in Europe and the Pacific, and the USAAF began finding and developing airfields to accommodate the programmed expansion of its wartime high combat strength of 273 combat groups. Although no more than one-third of these groups were in the CONUS at one time, the USAAF was tasked to submit full building projects. The new facilities were subjected to the rules of "Spartan simplicity" laid down at the outset of hostilities. As General Arnold explained in a policy in January 1942, "all frills and non-essential items would be eliminated and only the bare essentials would be approved" to meet the demands of the mission. On 4 February, the War Department directed that all buildings should be of theater-of-operations (TO) type (i.e., one story, tar paper structures), which were both cheap and easy to build. It was estimated that housing one man in TO barracks would cost $44 instead of $175 for the mobilization-type, two story wooden barracks formerly used (Futrell 1955:148-149). Garner (1993:33) indicates that the designation of "TO" to describe these buildings is incorrect because TO types, although temporary, were varied in modular proportion and intended for use outside the CONUS. Whelan et al. (1997:12) describe TO construction as "the least durable type of construction; it typically consisted of wood lath on wall sheathing covered in felt" and "[f]ew, if any, examples of T.O. construction survive."

Despite Arnold's demands for TO structures, the Series 700 mobilization-type construction, and later the Series 800, accounted for the majority of Army buildings constructed during this period. These building types originated with drawings in 1917 and were modified in the 1920s and 1930s. Ease and speed of construction were the key design criteria and anticipated manpower shortages made it necessary to use unskilled labor (Garner 1993:33-39). In addition, on 20 May, the Secretary of War said that no construction project would be approved unless it was essential, could not be postponed without hurting the war effort, could not be replaced by rented facilities, represented all possible economies, and was the most simple construction possible. Under the War Department reorganization of March 1942, the Chief of Engineers of the Services of Supply (later designated as the Army Service Forces) was directly responsible for all Army construction and acquisition of necessary real estate (Futrell 1955:148-149).

By May 1942, 45 new airfields were ready for operation and, with their tar paper buildings, were neither beautiful nor comfortable. Men living in them were plagued with dust or mud, heat or cold, according to the location of the field. All were put into operation before they were completed. At Marana, Arizona, for example, flying began on a level spot in the desert before landing strips were ready, and a detail of men had to fill rat holes in the earth each morning before the planes could take off. At many stations, facility capabilities were stretched by reducing the allowance of barracks space to 40 square feet per man and using temporary facilities such as tents, field kitchens, and pit latrines. Completion time for stations was short because construction was relatively simple, but costs sky-rocketed. The roughly constructed facilities also caused hardships, such as respiratory diseases, on personnel, and inclement weather turned partially completed camps into muddy bogs. Overcrowding was common at most stations and hotels in local communities were often used for military personnel (Futrell 1955:151-153).

Among the continental air forces, the First and Fourth Air Forces were so largely committed to defense assignments that the responsibility for unit training fell heavily upon the Second and Third Air Forces, thus requiring a major increase in their facilities. The Second Air Force, upon being relieved from the defense of the upper Pacific Coast in January 1942, was assigned the task of heavy bombardment unit training. By April, all of the existing facilities were being exploited to the utmost and new bases were needed. By January 1943, 14 new main bases were in use, including the Alamogordo Army Air Field in New Mexico (Futrell 1955:154-155).

Victory in Sight and the Atomic Age: Consolidation and Disposition of Facilities (1943–1945)

Allied unity became apparent in 1943 with victories in both the Pacific and European theaters of operation. The tide turned early in the Pacific war. After the battles of the Coral Sea, Bismark Sea, and Midway had sapped Japanese strength, General MacArthur's forces began the island-hopping campaign that systematically took control of airfields that could be used for the advance on the next stronghold. Beginning with Guadalcanal, the "Cactus Air Force" won air superiority and permitted Allied land forces to win bloody battles against the Japanese. Use of the P-38 Lightning reached its peak in the Pacific, where its two twin turbocharged engines provided a measure of safety over long expanses of sea (Boyne 1993:148, 164). Throughout the year there were Allied gains in the South Pacific, with victories in the Solomon Islands and New Guinea, and the start of the central Pacific offensive with the invasion of the Gilberts (Tarawa) (Boyne 1993:158; Sellers et al. 1976:359; Siefring 1982:182).

In Europe, the Allies were victorious in North Africa largely because USAAF and RAF aircraft had driven German and Italian air forces from the skies. The Russians went on the offensive in Russia, almost totally destroying the massive German army that Hitler sacrificed. The U.S. bombing campaign in Europe had a vital effect on this campaign by drawing much of the Luftwaffe away from the Eastern Front to defend the German homeland. The Allied invasion of Europe began with Sicily and Italy (Salerno) (Boyne 1993:158; Sellers et al. 1976:359; Siefring 1982:182). In January 1943, Winston Churchill approved the USAAF-created Operation Pointblank, the combined bomber offensive that would ultimately destroy Germany. This led to bloody raids intended to cripple Germany by destroying its industry, especially ball bearing plants and oil refineries. These daylight raids were successful but costly, with losses of up to 30 percent of the attacking forces to enemy fighters and flak. It became obvious that to secure air superiority over Europe, long-range fighter escorts would be needed to protect the bombers (Boyne 1993:154).

By 1944, victory was in sight. The Pacific operations were destroying the Japanese with invasions of the Marshall and Mariana islands and the beginning of the air war on Tokyo. In late 1944, the first B-29 Superfortresses were conducting raids against Japan from Chinese bases. The Allied invasion of Normandy on 6 June, and the subsequent U.S. entrance of Germany in September, had the once powerful Nazi empire on the defensive. The last big German counteroffensive, and perhaps their last chance to turn the war around, ended in defeat near Bastogne, Belgium, in the Battle of the Bulge. By this time, American war production of airplanes and materiel had reached twice that of Germany (Boyne 1993:169; Sellers et al. 1976:359). In early 1944, the U.S. launched massive air raids, hundreds of bombers escorted by hundreds of fighters (mostly P-51 Mustangs and P-47 Thunderbolts), against German aircraft factories. In five days, known as "The Big Week," 3,800 sorties were flown and the U.S. gained undisputed air superiority. The first raids against Berlin in March 1944 were a clear signal to the Germans that the war was lost. Although the Luftwaffe would occasionally muster enough strength to attack the bombers in force, it never came near regaining air superiority, even when it brought its wonder weapon jets (Me 262) into action (Boyne 1993:155-156). The Nazis also began launching the first surface-to-surface guided missiles, known as the V-1 (Vergeltungswaffe, or Reprisal/Vengeance Weapon), across the English Channel into London. Between June and September 1944, 5,430 V-1s were fired against England (Mattson and Tagg 1995:35). By the summer of 1944, scientists of the Manhattan Project had succeeded in splitting the uranium atom, creating the chain reaction necessary to make an atomic bomb. Uranium 235 and plutonium were being produced in the quantities required for the new weapon (Thomas and Witts 1977:8).

In 1945, the Allies converged to defeat both Germany and Japan. In the Pacific came the decisive battles of Manila, Iwo Jima, and Okinawa. USAAF B-29 low altitude raids on Japan were devastating Japanese cities with both precision bombing and incendiary area raid tactics. With no Japanese defense against these raids, the U.S. had achieved true air power. In Europe, the Rhine River was crossed and American and Soviet troops met on the Elbe River, successfully surrounding the remaining German forces. Hitler committed suicide in his bunker in Berlin as the Russians destroyed the city around him. Victory in Europe (V-E Day) came on 8 May 1945 when the now leaderless Germany surrendered. Unfortunately, this victory came too late for President Roosevelt who had led the way to it; he died on 12 April. Even with an ultimatum at the Potsdam Conference in July, the Japanese were determined to fight to the death. During this same month, the U.S. exploded the first atomic bomb on the Alamogordo Bombing and Gunnery Range in New Mexico as the successful conclusion to the Manhattan Project. To eliminate the expected heavy loss of life of Allied soldiers in a land invasion of the Japanese homeland, atomic bombs were dropped on Hiroshima (6 August) and Nagasaki (9 August). This led to Victory over Japan (V-J) Day on 15 August and the official Japanese surrender on 2 September 1945 (Boyne 1993: 170; Sellers et al. 1976:359).

During the latter half of 1943, the USAAF reached the peak of its activity in the CONUS with 345 main bases, 116 subbases, and 322 auxiliary fields (Futrell 1955:162). As the U.S. role in the war heightened, and strategic daylight precision bombardment became standard operating procedure, the need arose for quick training of a multitude of aircrews for the four engine, Heavy bombers (Davis 1995:47). The USAAF trained and equipped these air forces, which were now making their impact in the war overseas. Other responsibilities, such as continental air defense, had been greatly reduced, resulting in drastic cutbacks in operations and adaptation of existing facilities to new needs. The USAAF directed that new facilities must be essential, rather than just desirable, and in January 1944, General Arnold ordered that construction be limited to meet "critical requirements developing from changing operational needs for which existing facilities . . . are completely inadequate." Most new construction was closely connected with the needs of Very Heavy bombardment training. Although for limited training the B-29 could use 6,000 ft runways, for full training they needed 7,000 by 150 ft runways designed to support a 120,000 pound gross load. Housing and maintenance requirements for Very Heavy bombardment groups, largest of all USAAF combat units, were in excess of the facilities available at most bases. Housing, in particular, was inadequate at first but during 1944 was expanded to fit the B-29 groups. Much of the later increase was along the Pacific Coast to facilitate deployment of Very Heavy bombardment units to the war in the Pacific (Futrell 1955:162-164).

In early 1945, the USAAF began disposing of their surplus airfields and ranges and contracts with civilian technical schools were canceled. The USAAF still retained most of its bases until the need for redeployment was determined. Many stations on stand-by were used for prisoner-of-war camps, housing foreign laborers, livestock grazing, or other uses that would allow the bases to remain available for reactivation if necessary. After the capitulation of Japan, these surplus facilities were closed, and by the end of December 1945, the USAAF held only 429 base installations (273 main bases and subbases and 156 auxiliary fields). The USAAF had met its strategic commitments before and during the war without serious delays attributable to failure to develop base facilities, but with the end of the war, the road to demobilization had begun (Futrell 1955:165-168).

The great victories in Europe and the Pacific had been won at a terrible cost of more than 120,000 USAAF casualties and 65,200 airplanes. Yet there is little doubt that America's overwhelming air power made the invasion of Europe possible and the invasion of Japan unnecessary (Boyne 1993:175). Air power helped end the Axis naval threat, turned the tide in favor of Allied ground forces, and destroyed the economic backbone of the Third Reich and Japanese Empire which brought about their eventual collapse. As Siefring (1982:182) said "It [the air force] represented modern warfare with all its horror and suffering, the vivid impact of which the German and Japanese people will never forget."

Winston Churchill gave the USAAF the greatest compliment when he said "They never flinched or failed. It is their devotion that in no small measure we owe our victory." WW II saw the USAAF come of age and culminated with making it an independent branch of the Armed Forces: the United States Air Force (Siefring 1982:182-185).

Cold War (1945–1989)

In his book *The Cold War, A History*, Martin Walker (1994), U.S. bureau chief for the British *Gardian*, wrote, "The Cold War was truly a global conflict, more so than either of the century's two world wars . . . [It] was also the first total war between economic and social systems," and "the West prevailed because its economy proved able to supply guns as well as butter, aircraft-carriers and private cars, rockets as well as foreign holidays" (*American Heritage* 1994:102-103).

The explosion of the first atomic bomb in July 1945 at the Trinity site on the Alamogordo Bombing and Gunnery Range in southern New Mexico began the nuclear age and may be considered the start of the Cold War. The offensive use of the bomb on Japan illustrated the destructive capabilities of nuclear weapons and increased the world concept of deterrence through strength in military technology. These events spurred a period of intense technological experimentation throughout the world. The incorporation of deterrence into national strategy and policy was the primary force behind the escalation of the arms race during the Cold War (Lewis et al. 1995:24-25; Rhodes and Green 1995:110). This is illustrated in Joseph Stalin's statement to his leaders in 1945: "Provide us with atomic weapons in the shortest possible time. You know that Hiroshima has shaken the whole world. The balance has been destroyed. Provide the bomb—it will remove a great danger from us" (Newhouse 1989:53 in Lewis et al. 1995:27).

The political balance of world power, especially in Europe, was severely altered with the conclusion of WW II. The Grand Alliance of the U.S., Britain, and Russia (United Socialist Soviet Republic [U.S.S.R.]) had defeated the Axis powers of Germany, Japan and Italy. However, the post-war period witnessed a rapid reversal in the political relationship between the U.S. and the U.S.S.R. The polarization of the ideological and political objectives of the two countries culminated in what became known as the Cold War. The U.S. perception of the U.S.S.R. during the early years of the Cold War was one of fear, mistrust, and suspicion. American citizens believed that the Soviets were developing a first strike force and had technical forces superior to those of America. Although not a war in the conventional sense, this conflict was waged with varying intensity between 1945 and 1989. The Cold War was conducted, for the most part, through deterrence rather than direct conflict. This deterrence was based on the ability and preparedness of each country for a first or retaliatory strike (Lewis et al. 1995:23-24).

The USAAF, soon to become the U.S. Air Force, played an extremely important role in guiding the U.S. government to establish a strategy of national defense and containment of communist expansion and aggression around the world. The evolution and advancement of missile and aviation technology that occurred during the Cold War resulted in the modern, post-war material culture of the Air Force. The various facets of technology, architecture, and engineering related directly to the evolutionary development of individual air defense systems nationwide. The Cold War and the development of more destructive nuclear weapons also had a great psychological impact on the civilian population of the U.S. and its civil defense preparations (Lewis et al. 1995:24).

The build-up of conventional armed forces after WW II, and strategic nuclear offensive and defensive systems, also altered U.S. domestic economy due to the massive defense budget during the Cold War decades. Cold War funding, the arms race, and policy and strategy led to the construction of large numbers of facilities on USAF installations in response to the perceived threat of a nuclear holocaust (Lewis et al. 1995:24). As General Bernard A. Schriever said, "In the face of the challenge confronting us in the world today, the U.S. Air Force must not only maintain powerful forces in being, it must also develop, as rapidly as possible, the new weapons systems capable of meeting the potential aerospace threat of tomorrow—and the day after tomorrow" (Glines 1963:31 in Lewis et al. 1995:63).

The U.S.-U.S.S.R. arms race was the major symptom of the Cold War, with each country matching the military developments of the other. The USAF and its world-wide defense network grew to become the principal strategic deterrent in the U.S. This evolutionary process required the construction of training, combat, combat support, and maintenance facilities; longer and stronger runways; and extensive housing and community facilities for personnel and their dependents. Developments and trends driving the USAF included the number and conditions of facilities remaining from WW II, fluctuations in the size of the Air Force, requirements of facilities driven by the development of weapon and communication systems technologies, and human resources concerns (Lewis et al. 1995:64-65).

Inception of the Cold War (July 1945-January 1953)

At the end of WW II, the threat of another war seemed remote. The victory had been complete and the only potential threat, the Soviet Union, was exhausted by the conflict. In August 1945, U.S. forces were operating in almost every military theater, but within two years only minor forces remained in Germany, Japan, and a few strategic outposts (Boyne 1993:178-185). The origins of the Cold War lie in the expansion of the Soviet Union into Central Europe at the close of the war. Although the Soviet Union had been ravaged by the war, it still had the will to resume both its traditional expansion and political infiltration into the countries that bordered it. Between 1945 and 1948, the Soviets consolidated control of most of the land they occupied in 1945 and pursued rapid development of nuclear weapons and long range delivery systems to achieve a strategic military balance (Boyne 1993:178-185; Hoffecker et al. 1996:3). U.S. policy and strategy during this time focused on air defense, maintenance of economic and military stability in Europe, and deterrence (Lewis et al. 1995:30).

The U.S. feared the economic and political vacuum in western Europe would be filled by the U.S.S.R. and thus sponsored the reconstruction of western Europe through a massive infusion of capital, expertise, technology, and influence. The Truman Doctrine and

Marshall Plan (Economic Recovery Plan) of 1947 were the beginning of the U.S. containment policy to stem Soviet influence in Europe. Demobilization in the U.S. began immediately after the war. The USAAF was drastically reduced in both personnel and aircraft. Although General Carl Spaatz, General Arnold's successor, indicated the need for maintaining a military and industrial base sufficient to react to a new conflict, the post-war Air Force was reduced from a wartime high of 273 to just 55 regular combat groups by December 1946. These groups were placed within four commands created in March 1945 by the War Department: Strategic Air Command (SAC), Tactical Air Command (TAC), Military Airlift Command (MAC), and Air Defense Command (ADC) (Boyne 1993:178-180; Lewis et al. 1995:28).

The reduction in force was offset by General Arnold's vision for the future, which led to the establishment of the Weapon Systems Project Office method to manage the rapidly expanding research and development of new era aircraft, and the USAAF Scientific Advisory Group to preserve the relationship between scientific academics and the military (Lewis et al. 1995:67). This focus on new technology led WW II bomber veteran Major General Hugh Knerr to remark, "The aerial missile, by whatever means it is delivered, is the weapon of the Air Force" (Boyne 1993:184).

The U.S. continued its atomic bomb experimentation with explosions of the bomb near the Bikini Islands in 1945 (Sellers et al. 1976:376). To place a check on the escalation of these nuclear capabilities in 1946, the Soviet Union and leading governments of western Europe appeared to be in favor of the concept of a United Nations (UN) regulation of nuclear technology (Lewis et al. 1995:27). U.S. President Harry Truman, who had succeeded Roosevelt, sponsored the Baruch Plan to turn over all fissionable material and nuclear weapons capabilities to the UN. This plan failed because both the U.S. and U.S.S.R. lacked the faith in the UN to entrust their security to it. Thus, the U.S. established the McMahon Act which placed tight controls on the export of American nuclear technology and created the Atomic Energy Commission to develop and regulate this technology (Lewis et al. 1995:27).

The National Defense Act of 1947 established the DoD and created the Air Force as a separate branch of the armed forces. The Army Air Forces, Army Air Corps, and the Air Force Combat Command were subsumed under the Air Force, which gained authority for strategic missile development, with tactical missile development falling on the Army (Lewis et al. 1995:27,67). President Truman concentrated military funding on developing the operational strength of SAC's B-29, B-36 Peacemaker, B-47 Stratojet, and B-50 Superfortress bombers to enforce containment policies. These bombers provided the only delivery system for nuclear weapons but were slow and depended heavily on fighter escort. In 1946, only the P-51 Mustang was operational, but by the late 1940s and early 1950s a number of tactical aircraft became available. The B-45 Tornado (the first U.S. jet bomber and first plane to carry nuclear weapons) and B-57 Night Intruder were tactical bombers adapted to carry both conventional and nuclear weapons. Attack aircraft included jet fighters such as the F-80 Shooting Star, F-84 Thunderjet, and F-86 Sabre, all of which were later successful in the Korean Conflict. Little emphasis was placed on long term research, leading to the temporary abandonment of missile research and development (Lewis et al. 1995:28, 75, 96-99).

In spite of a concentration on maintaining readiness and a bomber force structure, research and development within the USAF became stagnant between 1946 and 1949 due to budgetary constraints and organizational problems. This situation changed when retired Lt. General James H. Doolittle became an advocate for research and development and prompted the creation of the Air Research and Development Command (ARDC) (Lewis et al. 1995:57-68).

The Cold War became a reality in 1948 with the Berlin crisis. As early as 1946, Winston Churchill had proclaimed that an iron curtain had descended across the European continent, "from Stetin in the Baltic to Trieste in the Adriatic" (Boyne 1993:185). The Soviet Union made this threat real with the blockade of all land routes leading into West Berlin through East Germany in 1948. The U.S. responded with the Berlin Airlift, bringing food, fuel, and supplies to German citizens of East Berlin cut off from the necessities of life (Boyne 1993:185-187; Lewis et al. 1995:28). In August 1949, the

Soviets detonated their first atomic bomb and the Mao Tse-tung regime began creating a communist China. In response, the National Security Council (NSC) declared deterrence as the national military strategy, and Truman authorized development of the hydrogen bomb, rapid deployment of long range bombers, and additional reconnaissance. Strategic defense of the U.S. was chiefly in the hands of the Air Force by 1949 (Lewis et al. 1995:28-29).

By 1950, the Cold War had evolved into a global contest and both sides possessed atomic bombs and long range bombers (Hoffecker et al. 1996:3). NSC Document 68 concluded that the Soviet Union was working toward world domination and would neutralize the U.S. atomic advantage by 1954. The U.S. had to embark on a massive program to build up its conventional military capabilities and develop and produce the thermonuclear hydrogen bomb. As a result of NSC-68, the U.S. containment policy shifted from a strong point defense based in the CONUS to a perimeter or symmetrical defense around the world. The policy also changed from European economic intervention to a military build-up. In June 1950, North Korea invaded South Korea and by November, China aligned with the North. This event tripled the U.S. defense budget and, once again, American troops were committed to war in the Korean "police action" (Lewis et al. 1995:29).

Between 1951 and 1952, America signed a peace treaty with Japan and began a relationship with Vietnam to solidify influence and deter Communist expansion in Asia. As a result of the Korean conflict, U.S. research and development programs grew. Dwight D. Eisenhower was elected president and attempted to balance the budget while still maintaining a strong military force. Early warning systems expanded, including low-level surveillance. The British detonated their first atomic bomb and the U.S. tested their hydrogen bomb. By the end of this period, Eisenhower's New Look plan focused on nuclear striking power and the threat of massive retaliation to thwart Communist aggression (Lewis et al. 1995:29-30; Sellers et al. 1976-377).

At the end of WW II, the USAAF had 1,333 air installations in the CONUS, but by 1948 only 112 remained and of these only 90 were active. In addition, Air Force combat groups had been reduced to 48. The focus of the Air Force at this time was on the modernization and maintenance of existing bases rather than the construction of new ones. By 1949, however, deterrence became the national military strategy and air defense requirements called for strategically located bases. This, combined with the outbreak of the Korean conflict in 1950, forced the USAF to expand once again and by 1951 there were 120 combat groups. As a result, emergency construction programs were developed, existing bases were extensively renovated and modernized, and new bases were established. Modernization included construction of housing, operations, administration, fuel storage, and medical facilities (Lewis et al. 1995:65). Housing for personnel was one of the most critical problems on existing bases. The National Housing Act (Wherry-Spence Act) of 1949 established the Federal Housing Administration to ensure private financing of homes on or adjacent to installations for military personnel. At the time, the USAF began construction of up to 26,000 housing units on 49 bases across the country (Lewis et al. 1995:66).

The transition from a strong bomber force to the development, testing, and use of strategic missiles also had an effect on new construction at the bases. The Cold conflict required that the U.S. stay on top of the race to have the first and best weapons. This need is illustrated in one of SAC's objectives "to establish and maintain a global offensive capability of such superior striking power that it minimizes the need for using it" (Power 1958:171 in Lewis et al. 1995:69). The USAF research and development program implemented during this period resulted in the construction on bases of laboratories and testing facilities, which had an important role in strategic deterrence, air defense, and tactical operations (Lewis et al. 1995:69).

Nuclear Technology Escalation (January 1953-November 1963)

The period from the outbreak of the Korean conflict to the Cuban Missile crisis, an era of confrontation, was characterized by instability as the Soviet Union continued to seek a strategic military balance with the U.S. Primary strategic offensive weapons shifted to intercontinental ballistic missiles (ICBM) with thermonuclear warheads, and the escalation of nuclear weapons and technology intensified. This was accompanied by developments for survival that included hardened missile silos, airborne command and control, and the dispersal of nuclear bombers. Deterrence through intimidation was the driving force behind the U.S. strategy (Hoffecker et al. 1996:3; Lewis et al. 1995:40; Rhodes and Green 1995:110). The U.S. began establishing forces around the world to resist Communist aggression, threatening use of nuclear weapons as a deterrent. The death of Stalin and the concept of absolute deterrence helped bring an end to the Korean conflict in 1953 (Lewis et al. 1995:31).

In 1953, the Soviets gained hydrogen bomb capability, renewing the American concern about military preparedness. The Killian report, referred to as the Surprise Attack Report, found that the U.S. would hold the advantage in a nuclear air strike capability but was vulnerable to a surprise attack due to lack of an early warning system, inadequate air defense, and a growing Soviet bomber force. The report concluded by stating there was no certainty that a nuclear stalemate could be alleviated by science and technology. Recommendations were that the highest national priority should be placed on development of the USAF ICBM program, construction of an early warning system in the Arctic, and research and development of antimissile systems. Other recommendations included more intense intelligence gathering and dispersal of a long range bomber force across the country to ensure survival and the ability to retaliate. Limited nuclear war became an alternative idea to avoid Mutually Assured Destruction (MAD) (Lewis et al. 1995:32).

By 1955, the Atlas ICBM program was given the highest national priority within the ARDC. The B-52 Stratofortress became operational and joined the SAC air forces. These bombers were used heavily in the Vietnam War. The B-58 Hustler became the first supersonic bomber. As aircraft became faster they no longer required fighter escort but, instead, were fitted with defensive and offensive weapons to aid in survival. Tactical aircraft that could conduct close air support and interdiction included the F-4 Phantom II, F-100 Super Sabre (the first U.S. aircraft designed to operate at Mach speeds), F-106, and F-111. All of these fighters were successfully used in the Vietnam War, with the F-4 being the most widely used and successful fighter of the Cold War (Lewis et al. 1995:33, 75, 96-101).

Air-launched missiles such as the Quail, Hound Dog, Air Launched Cruise Missile, Advanced Cruise Missile, and Harpoon were used by SAC. The continental air defense radar system, consisting of three chains of early warning radars designed for early detection of enemy bombers and missiles (including the Distant Early Warning [DEW] line), was augmented by the Navy. The U.S. established the Southeast Asia Treaty Organization (SEATO) to deter communist influence and began sending military advisors to South Vietnam. The Warsaw Pact was formed to assure mutual defense of the Soviet Union and Eastern European communist nations. These included Poland, Hungary, Bulgaria, Czechoslovakia, East Germany, Romania, and the Soviet Union. In the U.S., missile testing was moved away from the coasts under the California Policy to make the programs less vulnerable (Lewis et al. 1995:33-34, 77).

Nuclear arms build-up continued into the late 1950s, a time of exaggerated fear of enemy strengths which resulted in more mistrust between the U.S. and U.S.S.R. Both sides relied heavily on aerial surveillance to keep an eye on the nuclear capabilities of the opponent. In 1956, Soviet Premier Khrushchev made his famous "We will bury you" statement to Western diplomats. Allied troops landed in Egypt to settle the Suez Canal crisis. SAC initiated a 24 hour alert status for up to one-third of its bombers and tankers at bases throughout its command. The North American Aerospace Defense Command (NORAD), a joint U.S.-Canada air defense venture, was established in 1957 and provided high-tech radar and satellite monitoring systems to provide early warning for enemy attacks. The Soviets successfully placed the satellites Sputnik I and II into orbit around the Earth. This led to the mythical "Missile Gap," which made the American public believe that the Soviets had achieved technical superiority over the U.S. Fallout shelters became a common sight throughout the country. The U.S. finally succeeded in placing the Explorer I satellite into orbit after a number of failures, and the National

Aeronautics and Space Act provided that all space activities would be devoted to peaceful purposes (Lewis et al. 1995:34-36).

Fidel Castro took leadership of Cuba in 1959 and steadily drifted toward the Soviet sphere of influence. American U-2 surveillance aircraft spying over communist countries was at its height, and the Soviet Union shot down one of the planes and captured the pilot, Francis Gary Powers. This incident initiated more emphasis on satellites for reconnaissance missions, which Eisenhower supported with large allotments of money. John F. Kennedy was elected president in 1960 and his administration was determined to move the U.S. ahead economically and be decisive and flexible in terms of foreign policy and national defense. Kennedy also questioned the massive retaliation defense strategy, leaning more toward Flexible Response, which provided for numerous options and made it clear that the U.S. would only use nuclear force in retaliation of a first strike. It was realized that nuclear weapons were no longer a viable military alternative. The U.S. forces could initiate Flexible Response because their bombers and missiles were better, more numerous, and survivable. The focus changed from a reliance on strategic bombers to one of a larger missile capability (Lewis et al. 1995:36-39).

In 1961, the crisis in Berlin threatened to become a full-scale confrontation between the U.S. and U.S.S.R. Khrushchev dissolved the problem by initiating the construction of the Berlin Wall to stop the escape of talented East Germans, such as the many scientists who migrated to the U.S. and Britain after WW II. At the same time the U.S. was becoming more involved in Vietnam through counterinsurgency methods. The Bay of Pigs incident occurred in 1962 when Cuban nationals failed in their attempt to overthrow Castro. The Titan missile became operational and was added to the SAC Alert force. Tension between the U.S. and U.S.S.R. reached its height in the fall of 1962 when Khrushchev placed missiles in Cuba. Kennedy was fully prepared to go to war to halt the Soviet objective of placing ground-to-ground missiles in an offensive position so close to the U.S. SAC began to intensify its defense posture by putting all aircraft on full alert and arming them with nuclear weapons. The ICBM force, including Atlas and Minutemen missiles, was brought into alert configuration. The U.S. Navy set up a blockade to keep Soviet ships out of Cuba. Finally, an agreement was made that kept the Soviets from building up Cuba and had the U.S. remove missiles from Turkey. Before the Cuban Missile Crisis came to an end, though, SAC was poised to strike with the most lethal array of weapons ever assembled (Lewis et al. 1995:39-40).

As in the 1950s, USAF bases across the country continued to expand to handle a growing work force and new technology. Housing was still a major problem. The Capehart Amendment to the National Housing Act was passed in 1955 to authorize use of quarters allowances to pay off Wherry housing mortgages. The USAF contracted for standardized housing with a plan to construct 46,500 units on 88 bases. The development and operation of new aircraft contributed to the construction, redesign, and renovation of runways and taxiways. Between 1950 and 1957, asphalt pavement was common for runways, taxiways, and aprons. As planes became heavier, missions more frequent, and more space for take-off became necessary for new jet aircraft, changes in runways and base locations became necessary. In 1956, the USAF began constructing all combat and combat support airfield runways of Portland cement concrete and making them thicker. The USAF also had to acquire more space to allow for approach and take-off corridors seven miles long and four miles wide, making it necessary for bases to be at least 15 miles from the nearest community. This distance also helped alleviate the three main concerns of the local populace: air traffic safety (addressing the hazards of high speed flight in and around public air space), storage of conventional and nuclear weapons, and noise (Lewis et al. 1995:66-67).

To keep pace with aircraft and weapons development, support facilities such as control towers and sophisticated tracking and communication facilities were necessary. The latter were a focus during the 1950s and 1960s when communication facilities for early warning systems, fighter-interceptor alert, and command and control became common on USAF bases. Air-launched missiles became the weapon of choice during the late 1950s and early 1960s, and the material culture from this developmental period is directly related to the operational missiles and the B-52 bomber. Facilities were constructed to accommodate other aircraft such as the B-36, B-1, and B-2. New weapons and operational missile systems required construction of launch control, crew support, and launch facilities, as well as fire- and explosion-safe transfer, assembly, maintenance, and storage buildings. The COE expended considerable effort upgrading ordnance handling and storage facilities to deal with nuclear weapons (Lewis et al. 1995:67, 75, 83-84).

Détente (November 1963-January 1981)

After 1962, direct confrontations ceased to occur and the Cold War entered a long period of relative stability that depended primarily on a strategic weapons balance of land-based and submarine-launched ballistic missiles. The balance was supported by satellite surveillance that permitted mutual monitoring of weapons build-up and deployment (Hoffecker et al. 1996:3). This era was further characterized by negotiations and arms limitation treaties meant to limit development of the superpowers' nuclear arsenal and lead to détente. Détente was a policy of lessening tension in relations between countries based on peaceful coexistence. The Limited Test Ban Treaty of 1963 began the détente phase. Even with the reduced friction between the U.S.S.R. and the U.S., development and maintenance of nuclear technology continued within the negotiated parameters of the treaties (Lewis et al. 1995:40-41).

The Limited Test Ban Treaty of 1963 between America, Britain, and the Soviet Union served to once again limit nuclear weapons testing since a voluntary test ban had ended during the Berlin Crisis in 1961. The U.S. experienced internal shock when President Kennedy was assassinated on 22 November 1963. Lyndon Johnson assumed the presidency and continued Kennedy's policies of Flexible Response. When Leonid Breshnev and Alexei Kosygin took control of the Soviet Union, both refused to negotiate an arms control agreement and instead instigated an aggressive program to reach strategic parity with the U.S. President Johnson embarked on a full-scale war in Vietnam after the Vietnamese attack on a U.S. destroyer in the Gulf of Tonkin. He increased the bombing of North Vietnamese positions over the next three years, and by the end of 1965, 485,000 U.S. troops were involved in the conflict. This action increased civil unrest in America with race riots and protests against the war. Johnson also sent U.S. troops to the Dominican Republic to stop the rise of Communism there (Lewis et al. 1995:41-42).

In 1966, the Soviets established an Antiballistic Missile system (ABM) around Moscow, raising concern throughout the world because this system ruled out the possibility of a successful retaliatory strike, thus upsetting the balance of power. This action resulted in the U.S. development of the Multiple Independently-Targetable Reentry Vehicle. This weapon could overwhelm an ABM system, was cheaper than missiles, and with only one warhead had "more bang for the buck" (Newhouse 1989:200-202 in Lewis et al. 1995:42). The U.S. also developed a Defensive Triad of reconnaissance, bombers and fighters, and missiles. U-2 and SR-71 reconnaissance planes and satellites kept a close eye on Soviet countries. The FB-111 medium range strategic bomber, adapted from the F-111 fighter, was designed, and the B-1 bomber replaced the aging B-52. Attack aircraft included the F-15 Eagle and the A-10 Thunderbolt II. The latter was one of the few aircraft specifically designed for an attack role. ICBMs, or land-based missiles, included the Atlas, Titan, Minuteman, and Peacekeeper (Lewis et al. 1995:79-81, 98-101).

As the USAF role in Vietnam increased between 1965 and 1968, SAC had to balance its resources between strategic deterrence at home and combat overseas. The Strategic Arms Limitation Treaty (SALT) talks began in 1968 and continued through 1979, with ongoing negotiations on the limit of ICBMs and ABM systems. The Nuclear Arms Nonproliferation Treaty, signed by 60 nations, made it clear that no country could transfer nuclear technology to countries that did not have it. It also stated that the U.S., U.S.S.R., and Britain were the only countries allowed to maintain nuclear forces. France, India, and China, who also maintained nuclear weapons, did not sign the treaty. In 1968, Richard Nixon was elected president and ordered the first withdrawal of U.S. troops from Vietnam in 1969. Strategic parity was reached between the U.S.S.R. and U.S. with continued Soviet developments in offensive and defensive nuclear weapons. In response, the U.S. developed its own ABM "Safeguard" system (Lewis et al. 1995:43-44). Even though the U.S.S.R. achieved strategic parity with the U.S., it experienced economic problems within its own country. The U.S. and the Soviets established trade relations, with the U.S. importing Soviet goods and exporting machine parts and grain to the

U.S.S.R. Henry Kissinger viewed reciprocal trade agreements as an important way to integrate the Soviet economy into the world economy, thus fostering an interdependence that would result in stability in the world political situation (Lewis et al. 1995:40-41).

The years between 1973 and 1980 were wrought with turmoil throughout the world with events such as the Arab-Israeli War (1973), conclusion of the Vietnam War (1975), Soviet invasion of Afghanistan (1979), and Iranian hostage situation (1979-1980). There was a steady development of détente during this time because new weapons development and deployment were low, although east-west relations were still strained. SAC forces were put on alert to keep the Arab-Israeli War from escalating into a superpower confrontation. The U.S. and U.S.S.R. signed a Nuclear Test Treaty limiting the extent and nature of nuclear testing. Jimmy Carter was elected and became the first president to test the U.S. defense system by going aloft in his airborne command post. The USAF began development of first strike MX (missile, experimental) missiles, designed for "silo-busting" and survival. In 1979, SAC initiated Operation Global Shield 79, the most comprehensive nuclear war exercises ever conducted (Lewis et al. 1995:45-47).

A New Deterrence (January 1981-November 1989)

The Soviet invasion of Afghanistan began a renewed confrontation with the U.S. The period was also marked by a dramatic change in American foreign policy of the late 1970s when a state of parity was achieved between the U.S. and U.S.S.R. nuclear arsenals. President Ronald Reagan (elected in 1980) advocated an all-out military build-up as the only way to bargain with the Soviets, a strategy meant to exhaust rather than reform the U.S.S.R., thus removing parity. There was a massive build-up of military forces, which triggered new technological developments focused on upgrading and modernization. In the end, the Soviet Union finally succumbed to the social and economic strain of four decades of Cold War (Hoffecker et al. 1996:3; Lewis et al. 1995:47).

Economic stagnation continued in the Soviet Union. The U.S. military build-up imposed an increasing burden on a Soviet economy trying desperately to provide domestic commodities while developing new military technology. Arms reduction talks continued between the superpowers with the Strategic Arms Reduction Talks of 1982. In 1983, the strategic military balance was threatened when the U.S. proposed to construct a space-based missile defense system (“Star Wars”) and introduced the ultimate antimissile system (Strategic Defense Initiative [SDI]) which would make nuclear weapons obsolete. President Reagan believed that the Soviet Union was given a military advantage through the many treaties and they did not adhere to them. He suspended the SALT limitations and based his defense policy on SDI, building a defensive shield to destroy incoming ballistic missiles and their warheads. It was concluded that this defensive shield would reduce the likelihood of nuclear war. In 1983, the small Caribbean island of Grenada began to move politically closer to Cuba and the Soviet Union. Reagan initiated Operation URGENT FURY, a military action to ensure the safety of American tourists, students, and residents in the country. The Soviets shot down Korean Airlines flight 007 in 1985, and Reagan used this as an incentive to reestablish funding for the MX development program (Lewis et al. 1995:49-50; Rhodes and Green 1995:110).

In 1985, Mikhail Gorbachev succeeded Chernenko as Soviet General Secretary. He recognized the reality of the Soviet economy and the outdated nature of the communist doctrine, and began seeking Western advice on how to organize a democratic government and market economy. The Geneva Summit of 1985 and the Nuclear Risk Reduction Center Agreement and Intermediate Range Nuclear Forces Treaty of 1987 brought the superpowers to common ground, fostering cooperation in reducing arms and promoting communication. In 1989, the world watched the event that symbolized the end of the Cold War: the Berlin Wall came down, uniting the two Berlins as hundreds of East Germans crossed into the West without fear for their lives. Almost as a warning against falling into a false sense of security, as at the end of WW II, no sooner had the wall fallen than the U.S. armed forces took part in a large scale military operation against Panama. Operation JUST CAUSE, which ended on 14 February 1990, was the largest U.S. military operation since Vietnam (Lewis et al. 1995:50-51). It also staged the combat debut of one of the USAF's best kept secrets, the F-117A Nighthawk fighter, more commonly known as the Stealth (Boyne 1993:307).

As a result of the Cold War, USAF bases had to be developed beyond their WW II infrastructures to facilitate research and development, new missile technology, strategic bombers, command and control centers, and reconnaissance and intelligence systems. Properties associated with research and development included laboratory buildings, test animal facilities, launch complexes, guidance and tracking facilities, and rocket testing tracks. These types of facilities were being continuously modified to incorporate new technological advances. For missile programs, property types included silos, launch and command centers, hardened communications links, dormitories, munitions storage and maintenance structures, and docks and railroad transfer stations. Hangars, runways, dormitories, munitions loading and storage areas, and fuel and alert facilities were constructed for housing and maintaining strategic bomber and reconnaissance aircraft. Property types representing command, control, and communications included subterranean, concrete-reinforced structures, communications facilities, antennae, and satellite dishes. Special hangars, photographic laboratories, and communications facilities were necessary for reconnaissance and intelligence systems (Lewis et al. 1995:106-107).

The Current Era (1990-present)

Although the Cold War ended with the fall of the Berlin Wall and dissolution of the U.S.S.R., the USAF recognized the importance of retaining air superiority. Secretary of Defense William Perry said, "Everything else we do depends on this air dominance," and ACC commander General Richard Hawley stated that, "This nation's war fighting strategies are founded on total dominance of the air" (Hawley 1997:6). With a 40 percent reduction in the USAF structure and a decreased presence overseas, the USAF has become an expeditionary force capable of deploying decisive combat forces from the U.S. to any theater (Hawley 1997:6). As Colonel Kurt Cichowski, commander of HAFB's 49th Operations Group, said "[now] the focus is just on getting anywhere necessary on short notice" (Anderson 1997:1).

Transition into the Future (November 1989-Present)

In the post-war era, the Reagan administration called for bigger military budgets which coincided with the advent of new equipment. F-15s and F-16s began to line the nation's airfields and the B-1B bomber came on line with SAC. As the U.S.S.R. began to show signs of dissolution, the U.S. military became aware of the potential for a crisis in the Middle East. Lack of military intelligence, though, left the U.S. unprepared for Iraqi leader Saddam Hussein's attack on Kuwait in 1990, which ultimately led to Operation DESERT STORM (the Persian Gulf War). An immediate build-up of American forces began in Saudi Arabia that included F-15, F-16, A-10, and F-117 aircraft, paratroopers, tanks, and Patriot missile batteries. After unsuccessful attempts to negotiate with Hussein, the U.S. initiated an air attack of unprecedented ferocity in January 1991. Special operations helicopters, a variety of missiles, B-52G bombers, and fighters destroyed the Iraqi command and control and radar defense systems. The Iraqi Air Force was defeated easily with unquestionable U.S. air superiority. The Gulf War brought a patriotic response from the American public and the war was fought with an aggregate force of regular, reservist, and Air National Guard troops (Boyne 1993:299-312).

With the Gulf War victory, air power, so important in all of the wars beginning with WW II, was raised to a higher level—that of space power. Probably the most important aspects of the war was that space technology became an integral part of combat and proved crucial to the outcome of the conflict. Also, the U.S. established itself as the world's unmistakable sole superpower with its air and space supremacy. Space is the natural extension of the USAF's operating medium. The USAF operates over 90 percent of all military space systems and supplies. Although there are no weapons in space, its use has become an integral part of every form of combat from precision bombing to Special Operations Forces operating in radio silence behind enemy lines. Air Force Space Command is tasked with using space as a force multiplier for weapon systems and for gathering global information. The Navstar Global Positioning System (GPS) satellites were used by air crews for dropping supplies and locating pickup zones for operational forces in both operations JUST CAUSE and DESERT STORM. Individual soldiers and aircraft carry GPS units to pinpoint targets (Boyne 1993:316-319).

Even as the Gulf War was being fought, the USAF was downsizing and reorganizing. Because of the lack of clear lines of distinction between tactical and strategic operations in the Gulf War, it was determined that the triad of SAC, TAC, and MAC could be streamlined in structure. Air Combat Command combined the former SAC and TAC elements for integrated combat operations with a focus on deterrence and limited wars. Air Mobility Command combined the airlift capabilities of MAC with about half of SAC's former tanker force, creating a global support organization. The Air Force Systems Command and Air Force Logistics Command also merged into the Air Force Materiel Command (AFMC). The old wing structure consisting of a single aircraft type has been replaced with a new strategy combining fighters, bombers, tankers, and reconnaissance aircraft. The current U.S. strategy is based on ample warning time of a threat in order to reconstitute the industrial base and armed forces (Boyne 1993:319-321).

The USAF is looking toward the future with development of the B-2 Stealth bomber, the YF-22, and the C-17. Manned space exploration has become a focus once again for the USAF (Boyne 1993:325-329). The spectrum of future USAF operations will extend from high intensity global conflict to supporting humanitarian efforts. Secretary of the Air Force Dr. Sheila Widnall characterized "Global Engagement" by stating, "It's our continuing commitment to provide America the air and space capabilities required to deter, fight and win" (*Airman* 1997).

NEW MEXICO AND HOLLOMAN AFB

New Mexico, and more specifically what is now HAFB, contributed greatly to WW II and the Cold War. For WW II, Vandiver (1996:1) states that, "Together, the two areas [Alamogordo Army Air Field and Alamogordo Bombing and Gunnery Range] formed one of the most unique and important bomber training facilities in the United States." The facilities were in use from 1942 to 1945 during the final two historic periods of WW II (Periods 3 and 4). In the Cold War era,

> HAFB has been significantly shaped by various political policies, military policies, defense strategies, and technological developments that are aspects of the ACC Cold War context. . . . Perhaps the most obvious [role] Holloman AFB played in the history of the Cold War relates to the technological developments that were driven by political and military policies. Holloman AFB contributed to the sense of national security by being at the forefront of developing ever-greater technical expertise and 'bigger and better' weapons systems (Lewis and Staley 1994:14).

HAFB's best defined relationship to technological development occurred during Periods 5 and 6 (July 1945-November 1963) when the base was used primarily for research and development and missile testing (Lewis and Staley 1994:14).

What follows is a brief history of HAFB as it fits within the national context described previously. The first period, Outbreak: Augmentation of Facilities (1939-1940), is not included because it does not apply.

Disaster: Hemispheric Defense (1940–1941)

A number of facilities and a substantial amount of land directly related to support of the WW II effort were in New Mexico and included aircrew training bases with associated airfields and ancillary bombing and gunnery ranges. During the war, New Mexico supported nine major USAAF bases, five of which were for bombardier training, and at least 13 bombing and gunnery ranges (Couchman 1994:49-54; Walker 1994b:55). Alamogordo and the Tularosa Basin played a vital role. Alamogordo was the home of the nearby Alamogordo Army Air Field (AAAF) and the Tularosa Basin was the site of the Alamogordo Bombing and Gunnery Range (ABGR) (Figure 2). The AAAF mission was to train crews for duty in B-24 and B-29 bombers, while the ABGR served as a practice bombing site for hundreds of crews from bases throughout the country (Vandiver 1996:1). The installations were acquired in late 1941 and in use by

Figure 2. Alamogordo Army Air Field (Alamogordo Air Base on this map) and the Alamogordo Bombing and Gunnery Range, June 1943

Figure 2. Alamogordo Army Air Field (Alamogordo Air Base on this map) and the Alamogordo Bombing and Gunnery Range, June 1943 (courtesy of Dan King, HAFB Air Space and Range Operations).

1942. By May 1943, AAAF was one of 14 newly built air bases in use by the Second Air Force to facilitate the necessary increase in bomber aircrew training and to meet the original Air Corps objective of 84 combat groups (Futrell 1955:143, 155).

Although the U.S. did not enter the war until December 1941, Alamogordo had already been designated as a site for a bomber crew training facility. In April 1941, during a meeting between General Arnold and Vice Marshal Sir Guy Garrod, RAF Chief of Training, the U.S. granted the British government the right to establish one of the RAF training facilities at Alamogordo, an agreement which initiated construction of Alamogordo Army Air Base (Mattson and Tagg 1995:8; Vandiver 1996:1). Although the base was originally intended to be a training site for the British Overseas Training Program, after Pearl Harbor it was incorporated into the USAAF instead (Culbertson 1972:16; Meeter 1967:185). The RAF's triangular, three runway design and three area arrangement of the cantonment (i.e. the Main Base, West Area, and North Area) was retained during construction, but the new primary mission of the soon-to-be-established base was to train American bomber crews (Vandiver 1996:1).

In October 1941, New Mexico ranchers owning and/or leasing lands designated for the establishment of the ABGR near Alamogordo were ordered by the government to dispose of their livestock in anticipation of evacuating the area (Mattson and Tagg 1995:8). Original land acquisition consisted of about 5,900 acres of government-owned land (the base proper), with the range comprising 1,243,000 acres of Grazing Service (later BLM) and private land. The range encompassed most of the lands now contained in WSMR and part of what is now HAFB (Department of the Air Force 1986:4; Hawthorne 1994:23).

Characteristic of the difficulties encountered in the acquisition of the military ranges, the Board of County Commissioners of Otero County protested to the War Department, but to no avail. As with other western states where large tracts of public domain land existed, there were few areas, no matter how barren, in which someone, especially cattlemen, had not acquired a vested interest (Futrell 1955:161). On 19 November 1941, a group of officials from Headquarters, Fourth Air Force, visited the area to inspect the site of the proposed military installation. The military, under the authority of the Second War Powers Act, acquired the necessary privately owned ranch land and federal grazing lands by rental agreements. On 1 January 1942, the Grazing Service informed ranchers that their leases had been suspended and stock would have to be removed immediately. The ranchers were required to be off their lands by 15 February (Hawthorne 1994:23; Mattson and Tagg 1995:8).

Intervention: Expansion of Facilities (1942–1943)

On 6 February 1942, the U.S. Army COE cut a barbed wire fence as the initial step in establishing AAAF. The base was originally designated the Alamogordo Field Training Station (May 1942), changed to Alamogordo Army Air Base (AAAB) in June, and finally named the Alamogordo Army Air Field in November, by which it would be known until the end of the war (Mattson and Tagg 1995:8; Mueller 1989:245). The ABGR, operational by May 1942, may also have been called the White Sands Bombing and Gunnery Range at one time (Culbertson 1972:16-17; Mueller 1989:245).

Initial construction on AAAF was conducted by men of the 56th Material Squadron from Davis-Monthan Field in Arizona. The work began on 10 April 1942 and moved at a rapid pace through June. Some barracks were ready for use, but there was no electricity and water had to be hauled in by trucks (Mattson and Tagg 1995:8). On 5 May 1942, the 359th Headquarters Squadron arrived as the first organization assigned to the new installation. On 1 June, Colonel Ames S. Albro, first commander of AAAB, officially announced the USAAF's occupation of the base as it became operational as a heavy bombardment unit training base under the command structure of the Second Air Force, which had been relieved of coastal defense duties (Mattson and Tagg 1995:8-9; Vandiver 1996:2). The 301st Bomb Group became the first operational air group to arrive as permanent base units were activated. Although initially equipped with B-17 Heavy bombers, AAAF Bomb Groups would switch to B-24 Heavy bombers by December (Figures 3 and 4). Aprons, runways, taxiways, hangars, and range targets had been constructed on the base and bombing range by this time, and bomber crew training began (Mueller 1989:248; Vandiver 1996:2). The crews trained at the base would proceed to combat units in England and become part of the new high altitude, precision daylight bombing concept being conducted over Europe.

Victory in Sight and the Atomic Age (1943–1945)

In January 1943 there were 4,649 personnel at AAAF. As bomber crew training intensified, so did mishaps because of the accelerated training schedule with inexperienced pilots flying four engine bombers. During the first six months of the year, 14 B-24s crashed and 102 of 137 air crew personnel involved were fatally injured. Through March 1944, AAAF served as an Overseas Training Unit (OTU) with a primary mission of training flight crews for combat. Thousands of men and hundreds of crews in dozens of bomber groups and squadrons underwent the final stages of their training before receiving combat assignments in Europe and the Pacific. These crews would contribute to the beginning of Allied air superiority over both theaters of operation. The bomber groups, from AAAF and other air bases across the country, flew missions day and night, in good and bad weather, across the Tularosa Basin in preparation for their roles as

Figure 3. “B-24’s on Ramp [at AAAF], Old Baldy Mountain [Sierra Blanca] in Background” (Alamogordo Army Air Base [1942]).

Figure 4. B-24 Liberator flying over the white sands near AAAF, ca. 1942 (Alamogordo Army Air Base [1942]).

combat bomber crews (Vandiver 1996:2-3). The 29 July 1943 issue of the *Alamogordo News* reported that AAAF/ABGR was “one of the best [training facilities] in the country” and pilots could “bomb to their hearts content” because “they say it is the 4th largest [bombing range] in the world—with Germany, Italy, and Japan ranking 1, 2, 3” (Culbertson 1972:22-23).

In March 1944, AAAF underwent a major change in status when the official designation changed from OTU to Combat Crew Training Station (CCTS). That month, the last B-24 group finished training and the first of the new B-29 Very Heavy bombers began to arrive at the base (Figure 5). Until the end of the war, the primary mission at AAAF, now designated the 231st CCTS, was to train replacement crews to man Very Heavy bombers for duty against the Japanese in the Pacific Theater. B-17s also returned to the base for use as trainers for pilots with little flying experience. This procedure helped cut down the accident rate involving expensive B-29s and, although accidents still occurred, there was never a repeat of the horrible period experienced in 1943 (Vandiver 1996:3).

Cold War Inception (July 1945-January 1953)

In July 1945, activity at AAAF’s Tularosa Base Camp on the ABGR, northeast of the main base, increased (see Figure 2). The base camp was home of the 9th Bombing and Gunnery Range Squadron, whose duty was to maintain the systems of targets deployed on the range. In early 1945, the 9th was ordered to remove those civilians who had remained on the range despite the government’s evacuation orders in 1941 and 1942. The reason for the evacuation became clear when, on 16 July 1945, the U.S. exploded the world’s first atomic bomb in the extreme northwest corner of the bombing range at the Trinity site (Vandiver 1996:3-4). The Trinity site was named by Oppenheimer after a John Donne sonnet based on the Holy Trinity. The ABGR site was chosen for the first atomic test because it was flat and unpopulated yet close enough to Los Alamos for all the equipment to be easily transported to the area (Goodchild 1985:129-130). A cover story had been developed to explain the blast, and later in the day the *Albuquerque Tribune* printed the following, which was picked up by the wire services:

> Alamogordo, N.M., July 16—William O. Eareckson, commanding officer of the Alamogordo Army Air Base, made the following statement today: "Several inquires have been received concerning a heavy explosion which occurred on the Alamogordo Air Base reservation this morning. A remotely located ammunition magazine containing a considerable amount of high explosives and pyrotechnics exploded. There was no loss of life or injury to anyone, and the property damage outside the magazine itself was negligible. Weather conditions affecting the content of the gas shells exploded by the blast may make it desirable for the Army to evacuate temporarily a few civilians from their homes" (Weintraub 1995:90).

Figure 5. "B-29 Line at AAAF - 1945"

Figure 5. "B-29 Line at AAAF - 1945" (courtesy of Major Otto K. Mueller, [USAF, Retired]).

A Manhattan Project engineer, after witnessing the first atomic explosion, declared "The war is over." General Leslie Groves, head of the Manhattan Engineer District, replied, "Yes, it is over as soon as we drop one or two on Japan" (Seidel 1994:132). Less than one month later, General Groves' prophecy came true as atomic bombs were dropped on the Japanese cities of Hiroshima and Nagasaki, resulting in the end of WW II (Seidel 1994:132). The first detonation, and the use of the bombs in the war, had an earth shattering effect on the world and influenced much of the testing that later took place at HAFB (Mattson and Tagg 1995:9).

The event that resulted in the end of the war also led to the rapid draw down of U.S. forces. Although minimum training continued at AAAF, the 231st CCTS was redesignated the 16th Bombardment Operational Training Wing with the primary mission of discharging soldiers from the Army. On 18 October 1945, base officials announced AAAF would be retained as a testing area, but by November almost all training had ended and base personnel had been reduced from 6,000 to 2,000. On the last day of December 1945, AAAF personnel had dwindled to 20 officers, 38 enlisted men, and 7 civilians. On 28 February 1946, it was announced that the base would be inactivated. Activities at the airfield wound down with sales of surplus equipment, and the few remaining B-29s prepared to leave the following month (Culbertson 1972:25-26; Mattson and Tagg 1995:9; Vandiver 1996:4).
Even with the major reduction in personnel, combat strength, and production capability in the U.S., a host of new aircraft were emerging that revolutionized air power and ensured that the USAAF maintained technical air superiority, an important concept that prevails to this day. Surprisingly, some of the foremost proponents of strategic bombing now saw aircraft going the way of coast artillery and the battleship, to be replaced by the ballistic missile. General Hugh Knerr, a logistic genius, said, "The aerial missile, by whatever means it is delivered [i.e., even if not by an airplane] is the weapon of the Air Force" (Boyne 1993:181-184). It is not surprising, with this insight, that when AAAF was reactivated, it was assigned a missile development role.

One week after the B-29s left Alamogordo, the base inactivation was halted and on 10 April 1946 AAAF was reactivated as an operational base of SAC. The newly reopened base was under operational control of the Fifteenth Air Force, but in November 1946 the

Eighth Air Force took over. On 26 February 1947, jurisdiction was transferred to Air Materiel Command (AMC) with plans to use the base to support its Research and Development Program by providing facilities to develop and test pilotless aircraft, guided missiles, and associated systems and equipment. The unique facilities, environment, and isolated nature of the base had drawn attention to it for use as a possible missile development base as early as 1943. Site selection studies gathered for a U.S. missile test range during 1944 also included the Tularosa Basin as one of the potential candidates. Missile research began immediately as guided missile programs began their move to New Mexico. The move was expected to be complete by September 1947. Twelve hundred personnel transferred from Wendover AAF in Utah to AAAF to carry on a series of three year research projects. By this time, AAAF had a missile range 64 miles long (north-south) and 38 miles wide, which was felt by the USAAF to be superior to the facilities at Wendover AAF. Just nine days prior to the atomic bomb test at the Trinity site, the Army Ordnance Corps established White Sands Proving Ground (WSPG), which had its range just south of the AAAF range. These two installations worked together informally to schedule maximum efficient use of the combined ranges, which together were 100 miles long and 40 miles wide. At the outset of its multijurisdictional use in 1947, the facility was known as the New Mexico Joint Guided Missile Test Range (Department of the Air Force 1986:3; Mattson and Tagg 1995:9; Meeter 1967:185; Weitze 1997:22).

The transfer of programs and personnel from Utah and closing of Wendover AAF met with few problems. Three ongoing programs were involved in the transfer: the Boeing Ground-to-Air Pilotless Aircraft (Gapa), Jet Bomb (JB)-2 Loon, and the Tarzon (Tallboy [a British bomb] range and azimuth only). AAAF had been largely vacant for nearly two years, so the USAAF refurbished existing buildings and constructed new facilities at the installation to support the new missile programs. Preliminary studies focused on engineering issues associated with the research and development of a ground-to-air pilotless aircraft. On 23 July 1947, before the move to AAAF was complete, the first missile, a Gapa, was launched at the base. During the 1940s and early 1950s, many additional missile, rocket, and drone programs were tested, including the North American Test Instrument Vehicle (Nativ), Aerobee, Firebird, Falcon, Snark, Matador, Mace, and

Consolidated-Vultee ICBM/Intermediate Range Ballistic Missile (IRBM, pre-Atlas) (Figure 6). These studies were predominantly research and development of weapons systems and were generally characteristic of the earliest USAF programs in the post-WW II period. By late 1947, the USAF had the lead in developing and testing surface-to-surface pilotless aircraft, strategic missiles, and surface-to-air missiles required for national defense (Mattson and Tagg 1995:9; Weitze 1997:24-29, 49).

With most test programs, the Air Force provided the facilities and contractors used their own vehicles to conduct tests (Mattson and Tagg 1995:136-138). Many of the researchers at HAFB, which AAAF was redesignated in 1948, were scientists recruited from post-WW II Germany under Operation Paperclip, an early Cold War political and military strategy that sought to ensure scientific and military superiority for the U.S. In one of the earliest manifestations of the Cold War arms race, the U.S. and U.S.S.R. competed for the Peenëmunde rocket scientists (Lewis and Staley 1994:15; Weitze 1997). In addition to prominent scientists such as Dr. Ernst Steinhoff and Werner von Braun arriving to work on research projects, companies such as Hughes Aircraft Company, Land-Air Division of Dynalectron, Boeing, North American, Martin, Bell Air, Ryan, Convair, and Lockheed conducted tests on the base (Culbertson 1972).

With the initiation of missile testing came the need for comprehensive and well orchestrated, state-of-the-art instrumentation for recording data on the programs on HAFB and WSPG. These facilities included various photo, radar, and telemetering operations, and a communications system comprising a command network (Figure 7). Most vehicle launches used a variety of these stations in tandem. Dr. Steinhoff, an expert of range instrumentation needs in the Tularosa Basin and who would become the leading German scientist at HAFB, was responsible for streamlining the facilities on the integrated range (Best 1948; Land-Air Division 1950; Mattson and Tagg 1995:140; Weitze 1997:31-35).

HAFB was also selected as one three USAF bases for a role in the research, development, and testing of biological and chemical weapons systems. The Army was responsible for developing the warheads, while the USAF and Navy had responsibility for providing technical weapons’ requirements and integrating the experimental warheads into weapons systems (Weitze 1997:37).

In July 1950, the initial 3,550 ft long captive missile test track (later to become the High Speed Test Track [HSTT]) and control blockhouse were constructed for testing the Snark missile. This track was instrumental in the advancement of missile flight technology. A variety of programs were conducted on the track, including drone testing, flight control and guidance system research, aerodynamic tests, ejection

Figure 6. Nativ missile launch at the Missile Test Stands Area on HAFB in 1948

Figure 6. Nativ missile launch at the Missile Test Stands Area on HAFB in 1948 (HAFB Environmental Flight, Cultural Resources Photo Archives).

seat research, and speed tests (Figure 8). The latter included Lt. Col. John Stapp's famous Mach 0.9 sled ride. The track was extended by 1,521 feet in 1952 and to its current length of 35,000 feet in 1957 (Mattson and Tagg 1995:140). As part of this extension, numerous support buildings were constructed, including five concrete observation blockhouses, a vehicle assembly and maintenance building, a booster

Figure 7. Bern site (George 54) cinetheodolite ground station at HAFB, looking east, 26 November 1963

Figure 7. Bern site (George 54) cinetheodolite ground station at HAFB, looking east, 26 November 1963 (HAFB Environmental Flight, Cultural Resources Photo Archives).

conditioning building, fuel storage facilities, administration buildings, and many instrumentation stations such as pads for tracking cameras. The construction of the Horizontal Test Stand (HTS) was also included in the expansion (Bushnell 1959:22). The HTS was placed on HAFB because of Cold War tactics requiring that future missile development and testing be conducted away from the seacoasts for defensive reasons. The HTS was intended for Atlas ICBM engine tests but was apparently never used for that purpose. Instead, the facility was utilized for servicing liquid fuel sled engines for the HSTT (Mattson and Tagg 1995:140).

HAFB was also extensively involved with aeromedical research during the early Cold War and two complexes were constructed for this work. One complex housed the Holloman Zoo and the other the Daisy Test Track. Early aeromedical research was conducted between 1946 and 1950 in support of V-2 launches at WSPG. This testing consisted of sending spores, monkeys, and mice in V-2s to expose them to cosmic radiation. In 1950, aeromedical operations were transferred from WSPG to HAFB. Initial studies used balloons to transport equipment and test animals to high altitudes, but between 1951 and 1952, monkeys and mice were sent up in Aerobee rockets. This upper atmospheric research was designed to study the

Figure 8. I-beam sled hitting the water break on the 35,000 ft High Speed Test Track, ca. 1960/1961

(HAFB Environmental Flight, Cultural Resources Photo Archives).

Figure 8. I-beam sled hitting the water break on the 35,000 ft High Speed Test Track, ca. 1960/1961 (HAFB Environmental Flight, Cultural Resources Photo Archives).

biological effects of cosmic radiation and weightlessness, and altitudes of 36 miles were successfully achieved with rockets. Altitudes of up to 100,000 feet were achieved with balloons before launches were transferred to other locations in 1953 (Mattson and Tagg 1995:139-140).

In 1953, the Aeromedical Field Laboratory (AFL), created in 1951 to support programs at Wright Field in Ohio, was assigned to HAFB. The AFL included the Holloman Zoo, which provided test animals for biomedical research and also conducted research into the biodynamics of abrupt deceleration. The Zoo housed mice, hamsters, and cats and was the only Air Force agency to have chimpanzees, hogs, and bears. A part of the Zoo was the chimpanzee consortium, consisting of a 1,300 ft diameter outdoor area surrounded by a moat. The Zoo was part of the AFL (which later became the Aeromedical Research Laboratory (ARL), and finally the Primate Research Laboratory) from 1959 through 1971. Two of the most famous residents of the Zoo were HAM (Holloman Aero Med, originally named Chang) and Enos, the first 'chimpnauts,' who in 1961 preceded Mercury astronauts into space and were the first chimpanzees to make a suborbital flight and to orbit the earth, respectively (Mattson and Tagg 1995:11, 140) (Figure 9).

Figure 9. HAM and Enos in Space Trainers at the Holloman Zoo, ca. 1960

Figure 9. HAM and Enos in Space Trainers at the Holloman Zoo, ca. 1960 (HAFB Environmental Flight, Cultural Resources Photo Archives).

The influx of personnel and new programs increased the severity of local problems that began with the establishment of the base in 1942. Housing for base personnel was lacking and the scarcity of water was always a problem. The research programs, more than people, caused the water shortages. The HSTT, for example, used thousands of gallons for braking systems and test firings, and missile launches required huge reserves of water fire hazard control and for washing down the vehicles after using toxic fuels. Good quality water had to be used because the local water was highly saline and caused deterioration of the equipment. In 1947, the base began buying water from Luther Boles, a local farmer, and also bought or leased all lands adjoining Mr. Boles' wells (Bushnell [1957]:20-28; Culbertson 1972:27-28; Hawthorne 1994:107-108). Later, in 1954, HAFB purchased rights to water from Bonito Lake near Ruidoso, New Mexico, from the town of Alamogordo in exchange for building a pipeline from the lake to the base (Bushnell [1957]; Culbertson 1972:69-71).

In September 1947, the Air Force became a separate service. AAAF was renamed Alamogordo Air Force Base (AAFB) for a short time, until General Order No. 2, issued 13 January 1948 by Headquarters U.S. Air Force, designated the facility Holloman Air Force Base, as previously mentioned, in honor of Colonel George V. Holloman. Col. Holloman, who was an early pioneer in guided missile studies, was fatally injured in a B-17 crash in March 1946, so it was appropriate that a guided missile development base be named in his honor. The official dedication ceremonies marking the renaming of the base took place on 18 September 1948 (Mattson and Tagg 1995:9).

Over the next two years, HAFB would be subject to numerous changes in command and status. In early 1950, the Air Force decided to turn HAFB over to WSPG and transfer most of the ongoing programs to Banana River, Florida. U.S. Senator Clinton P. Anderson, New Mexico Attorney General Joe Martinez, and Alamogordo Mayor Eber McKinley successfully lobbied in Washington, citing HAFB's ideal location for military research and missile testing, and the Truman administration reversed the closure orders (Culbertson 1972:40-42). In April 1951, the base became part of the newly formed Air

Research and Development Command (ARDC) with the designation of 6540th Missile Test Wing. The test wing was originally a satellite to the Air Force Missile Test Center at Patrick AFB, Florida, but became a separate center in September 1952 with the designation 6580th Missile Test Wing (Meeter 1967:186).

On 1 September 1952, the operation of the joint HAFB and WSPG ranges was formally combined into the Integrated White Sands Range and placed under Army management. The ranges were combined because many of the missile development programs on the two ranges overlapped (Mattson and Tagg 1995:11). HAFB was raised to Center Status and became the Holloman Air Development Center (HADC) on 10 October 1952 and was designated a permanent Air Force installation under ARDC (Meeter 1967:186). Five years later, it was designated as the Air Force Missile Development Center (AFMDC) because HAFB was one of ". . . the most promising site[s] within the U.S. for important future developments in guided missiles and space technology" (Culbertson 1972:93).

Nuclear Escalation (January 1953-November 1963)

Many of the missile programs started in the late 1940s, such as the Aerobee and Falcon, continued into the 1950s and early 1960s. There were also a number of new programs such as the Hypersonic Test Vehicle, Cherokee, Duck, Ding Dong, Sidewinder, XQ-4, Goose, Rockaire, X-17, XQ-5 Kingfisher, XQ-10, Mace, Quail (GAM-72), and Nike-Cajun (Weitze 1997:56-85). The Killian Report of 1954, advocating ICBM development (especially the Atlas), provided support for HAFB. In addition, the Eisenhower administration supported the "dispersal" or "California" policy which required research and development be conducted away from seacoasts for defensive, economic, and political reasons. Much of the funding for HAFB's Snark testing was a result of Eisenhower's support of ICBMs and the Atlas, and the construction of other base facilities was related to the noncoastal emphasis (Lewis and Staley 1994:15). By 1950, many of HAFB's first missile programs had already come to a close and the focus was on continuing already established missile tests. Drone testing was also becoming a factor on the base, with a focus on creating target aircraft with performance characteristics closely simulating those of the high altitude supersonic U.S. and enemy aircraft also in development. Between 1954 and 1956, testing of weapons systems at HAFB had shifted toward components testing rather than research and development of full-scale vehicles, with an increased emphasis on HSTT sleds (Weitze 1997:49-66).

For the most part, though, missile testing declined when many programs, including the Matador, Rascal, Snark, and Navajo, were transferred to the newly established Patrick AFB, Florida, in 1950 (Lewis and Staley 1994:13). Although HAFB was selected as the final location for mid-1950s ICBM testing and training, the USAF overturned the selection, instead recommending Patrick AFB and what was to become Vandenberg AFB in California. It was determined that ICBM test ranges would require long range launch capabilities of up to 5,000 miles, and these coastal bases allowed launching over water toward distant islands. This decision, and an austerity drive in 1957, made it difficult for the Air Force to get and keep support for basic scientific research in the space program and many programs at HAFB were canceled before they began. A number of test stands and buildings were constructed but never used and most of the original ABGR acreage was combined with a comparable amount of WSPG to form WSMR in 1956 (Department of the Air Force 1986:4; HAFB 1962:4; Weitze 1997:77-89).

Testing of all the major guided missiles and experimental test vehicles of the 1947 to 1956 period had been completed by the end of the 1950s with the exception of the Aerobee. Focus at the close of the 1950s and into the 1960s was on several air-launched guided missiles, target drones, components testing for the extended 35,000 ft test track and the Radar Target Scatter Test Facility (RATSCAT), and guidance testing carried out at the Central Inertial Guidance Test Facility (CIGTF). Much of the remaining missile and drone testing, with a focus on Mace and Matador missiles and the BQM-34A Firebee drone, used the zero length (ZEL) launch facility at Able 51 in the late 1950s. This facility was a typical example of the U.S. early Cold War defense posture, constructed as an experimental building to protect a fighter plane during an atomic blast and to launch the plane into the air if the runways were disabled (Mattson and Tagg 1995:11, 139; Weitze 1997:85-94).

In addition to weapons testing, HAFB continued to be involved in important aeromedical research at the HSTT and ARL in support of the infant U.S. space program. The phasing out of the test track at Edwards AFB, California, led to all USAF track activities consolidating at HAFB. The HSTT gained national recognition and was instrumental in the advancement of missile flight technology. Between 1951 and 1957, tests in escape physiology, including the effects of ejection force, wind blast, and wind drag deceleration, were evaluated using sleds occupied by chimpanzees and humans to simulate pilot ejection from high speed aircraft. Dr. Stapp made 28 runs and attained a maximum speed of 937 feet per second, becoming the "fastest man alive." The ARL was heavily engaged in automotive crash force investigations and deceleration tests using the 240 ft long Daisy Test Track which was housed in the ARL compound. Use of a simulated Apollo space capsule crew couch was one of the many tests conducted on this track. Between 1957 and 1960, the ARL conducted Projects Excelsior and Manhigh, using high altitude balloons to test parachutes and pressure suits and the ability of pilots to perform under high stress, emergency conditions. Manned balloons reached heights of 125,000 ft to test the effects of space flight on humans and discover design principles for space capsules (Culbertson 1972:120; Department of the Air Force 1986:3; Mattson and Tagg 1995:141). Fulton and Cooper (1996) evaluated many of the ARL and HSTT buildings and provide a more in-depth discussion about the programs conducted at those facilities.

On 1 September 1957, the HADC was redesignated the Air Force Missile Development Center, and on 1 April 1961 the base became a part of the Air Force Systems Command (AFSC) (Meeter 1967:186). The base mission did not change between 1957 and 1970 under the command of AFSC. A tactical fighter wing arrival in July 1963 required construction of additional facilities and made HAFB a TAC operating base as well as a

USAF missile development and test site. New construction included a 63 bed hospital dedicated in June 1967 and a maintenance hangar completed in 1969 (Mueller 1989:248).

Détente (November 1963-January 1981)

HAFB remained active in guided missile and space research and development until 1968 when the 49th Tactical Fighter Wing (TFW) was assigned to the base (Lewis and Staley 1994:14). Missile testing and development dropped off but did not cease when the AFMDC was phased out in 1970. In that year, most projects were moved to Kirtland AFB in Albuquerque, New Mexico (Culbertson 1972:128). Developmental testing continued at the HSTT and the PRL at HAFB, but many of the old facilities and buildings associated with this missile testing were deactivated and an important phase of HAFB came to an end (Mattson and Tagg 1995:11). In July 1968, the 49th TFW began arriving at HAFB, where it became the first dual-based tactical fighter wing. It trained primarily at HAFB, with individual squadrons returning periodically to Europe for exercises (HAFB n.d.: 1-2).

When the AFMDC was deactivated, the 49th TFW assumed host responsibility for the base (Lewis and Staley 1994:14). On 1 January 1971, TAC assumed operational control of HAFB and it became primarily a fighter base. A new command structure, Tactical Training Command Holloman, was established to supervise the major TAC units assigned to the base (Mattson and Tagg 1995:11; Strader 1995:4). TAC's primary mission throughout the Cold War was "Preparation to deploy adequate forces to deter war and if deterrence fails, provide the margin of excellence to win . . ." (TAC 1978:I in Lewis and et al. 1995:58). They maintained fighter forces and tactical reconnaissance aircraft to fulfill this mission. TAC's reserve forces were an important part of the Cold War because they fulfilled the "ready to respond" requirements for tactical airpower in times of war or national emergency (Lewis et al. 1995:58). Initially, four flying squadrons at HAFB used F-100 and F-4D Phantom aircraft, and in August 1971 T-38 Talons arrived at the base. In May 1972, the 49th TFW was directed to perform combat duty in Southwest Asia and the entire wing deployed to Takhli Royal Thailand Air Force

Base. Between May and September 1972, the 49th flew more than 21,000 combat hours in OPERATION CONSTANT GUARD without losing a pilot (Strader 1995:7). HAFB was designated a Tactical Training Center in August 1977, and in June 1978 the 9th Tactical Fighter Squadron converted to the F-15 Eagle (HAFB n.d.: 1-2; Mueller 1989:248).

A number of construction projects were completed on HAFB during this period, including family housing in 1972, a small aircraft maintenance dock in 1974, a high velocity test track in 1976, two-phase improvement of family housing in 1977 and 1978, a bachelor officers’ quarters and 80 officers’ family quarters in 1979, and a CBPL (function unknown) building in 1980 (Mueller 1989:248). The West Area, consisting of administrative and operations facilities, expanded with the addition of the 449th Mobility Squadron in 1972, which later was replaced by the 49th Bare Base Systems Group. Bare Base was the only unit in the Air Force to maintain support equipment for establishing a tactical base of operations at any remote location in the world (Department of the Air Force 1986:4). The Bare Base facility occupied a large number of buildings, including earlier constructed and new buildings, and had a taxiway and aprons connected to the installation for ease of loading and unloading materiel and equipment into warehouses. In addition, alert facilities for housing a rapid deployment force were constructed in 1976 (Lewis and Staley 1994:16, 25-26).

Deterrence (January 1981-November 1989)

Between 1981 and 1989, the HAFB mission continued under the 49th TFW with few changes. During this time, the base began to support the 4th Space Warning Squadron, which provided instantaneous world-wide missile warning and functioned as a critical link in the USAF C^3I system (Lewis and Staley 1994:16). Facilities such as the HSTT, PRL, CITGF, and RATSCAT remained operable.

The Current Era and Transition into the Future (1990-present)

Tactical Training Command Holloman was inactivated and replaced by the 833rd Air Division in December 1990. The designated 49th Fighter Wing (FW) took operational control of the base in 1991 and sent two fighter squadrons to OPERATION DESERT STORM in Kuwait that same year. The last F-15 left HAFB in 1992 and the first F-117A Stealth fighters arrived from Tonopah Test Range in Nevada. By mid-1992, HAFB had three F-117A fighter squadrons and was the only base to host that fighter plane. The F-4 returned during this same time period for use by the 1st German Air Force Training Squadron, currently training at the base (Strader 1995:5-8).

Today, the 49th FW provides leadership to an Air Force installation containing three active runways and six flying squadrons. They currently fly the F-117A, AT-38B (used in training Taiwanese pilots), T-38, F-4E (German pilot training), and the MH-60G Pavehawk rescue helicopter (Strader 1995:21). In 1992, the resources and personnel of TAC were transferred to ACC (Lewis et al. 1995:58). Today, the 49th FW mission is to provide training to aircrews for rapid mobility and deployment world-wide to meet peacetime and wartime contingencies (HAFB n.d.: 3).

CHAPTER 5

BUILDING DESCRIPTIONS

All USAF buildings and structures can be divided into functional types regardless of the era of construction. The function of a military base, if it remains within the service branch for which it was built (in this case the Air Force), does not radically change through time except in the types of aircraft or test vehicles used. Whelan et al. (1997) developed three broad categories for WW II bases that encompass a wide range of installation types. Buildings and structures were classified according to their use, and many of the types could be found on all installations regardless of the mission. The USAF *Interim Guidance* Cold War Property Type list provides similar categories for the evaluation of post-1945 facilities (USAF 1994). This classification system has five broad categories of functional property types under which buildings and structures are grouped by use. The Cold War system does not distinguish between installation types, and most installations would have supported more than one of the broad functional property types. With few exceptions, the two classification systems are very similar. Building and structure types from both eras fall under the same broad functional property type. For this reason, and because the current project involves facilities from both eras, the Cold War Property Type list is used to categorize all properties.

The USAF *Interim Guidance* list of Cold War resources property types include: (1) Operational and Support Installations; (2) Combat Weapons Systems and Combat Support Systems; (3) Training Facilities; (4) Material Development Facilities; and (5) Intelligence Facilities (USAF 1994:67). Within each of these property types, a list of up to 12 subtypes further categorizes particular types of resources. The first classification of

HAFB facilities using these types was conducted by Fulton and Cooper (1996) during the initial base-wide architectural assessments on the base. This work resulted in the addition of a few subtypes to accommodate particular facilities investigated during that project (Fulton and Cooper 1996:39-41).

Each of the facilities investigated during the current project is identified within the refined property type subgroups (Table 6). The original function of a facility was used for placement on the list. Two subtypes

Table 6
Property Types and 34 Assessed Facilities

I. Operations and Support Installations (n=8)
∃Base and Command Centers
∃Missile Stations
∃Launch Complexes
∃Housing [Residential]
— Building 218
∃Storage
— Building 71
— Building 96
— Building 754
∃Base Retail
∃Recreation
— Building 322
∃[Administration]
— Building 200
— Building 205
∃Infrastructure
∃[Industrial]
— Building 302
∃Mess/Social
∃Communications
∃Medical
∃Documentation

II. Combat Weapons and Support Systems (n=7)
∃Missiles
∃Alert Facilities
∃Ground Vehicles and Equipment
∃Maintenance Docks/Hangars [Transportation]
— Building 291
— Building 300
— Building 301
— Building 1079
∃Communications
∃Storage
— Building 289
— Building 1236
— Building 1237
∃Memorial
∃Weapons Platform
∃Fuels
∃Documentation

III. Training Facilities (n=4)
∃Base Support [Education]
— Building 40
— Building 107
∃Flight Training
∃Intelligence Training
∃Combat Training [Education]
— Building 599
— Jeep Target
∃Combat Support Training
∃Launch Complexes
∃Combat Training Ranges
∃Impact Areas and Targets
∃POW Training Camps
∃Communications

IV. Material Development Facilities (n=15)
∃Research Laboratories
∃Manufacturing Sites
∃Test Sites
— Building 1116
— Building 1139
— Building 1142
— Building 1440
— Building 1442
— JB-2 Ramp
— Test Stand
∃Proving Grounds
∃Communications/Instrumentation*
— Building 900
— Building 1113
— Building 1133
— Building 1249
— Building 1284
∃Storage/Support*
— Building 1127
— Building 1285
— Incinerator
∃Documentation

V. Intelligence Facilities
∃Radar Sites
∃Spy Satellites
∃Listening Posts
∃Communications

*new subtypes added for the current project
[ ] WW II categories (from Whelan et al. 1997)

were added to the Material Development category for specific Cold War functional properties identified on HAFB that did not fit under existing subgroups. The new subtypes Instrumentation and Storage/Support are marked with asterisks in Table 6. Instrumentation was combined with Communications because of the similarity in function. Two subtypes were added to the Operational Support Installations to facilitate WW II property type, although both subtypes were also valid for Cold War properties. The new subtypes were Administration and Industrial. There were also four cases in which WW II and Cold War categories with the same function had different names based on their prospective lists. Two of these are under Training Facilities because the WW II list had one broad category for Education, while the Cold War list had many subcategories. In these cases, the Cold War functional name was used. All WW II category names are in brackets on Table 6 and in parentheses in the text.

As discussed earlier, HAFB's three part Cantonment Area reflects the typical RAF dispersal concept because the base was originally planned in WW II for training British aircrews (HAFB 1962:6; Mattson and Tagg 1995:8). These three locales are known as the Main Base, North Area, and West Area. A 1943 Post Map shows three runways in a triangular layout centrally located within the three improved areas, which are connected by roads and taxiways with parking aprons (Figure 10). The Main Base, with administrative and housing facilities, is south of the northeast-southwest runway. It includes a large housing and hutment area with separate WAAC (Women's Army Auxiliary Corps) and Colored sections, a hospital area, utility yard, motor pool, and Civilian area and subdepot. Aircraft maintenance hangars and a parking apron are adjacent to the runway. A taxiway runs from the east end of this runway to the North Area, which contains buildings and hangars, a parking apron, and numerous round aircraft hardstands. The taxiway, with offset hardstands, continues around to the West Area, which is set up similar to the North Area. Lewis and Staley (1994:16) indicate that the North and West areas were strictly mission related. Major Otto Mueller (USAF, Retired), who trained B-29 combat crews at AAAF between 1944 and 1945, remembers ". . . the base as having a Main Area where Headquarters of the 231st Base Unit were located, and the North Area and West Area where flying operations were conducted"

(Mueller 1995). A periphery road circles the entire layout. The Munitions Storage Area is just northeast of the North Area and a training area with Shooting In Butts, Machine Gun and Pistol Range, 4 Skeet Ranges, and the Jeep Target are to the northwest. The entrance to the base is from the southeast, off U.S. Highway 70, as it is today.

Very little of the original WW II Army Air Forces post exists today, although the layout remains the same with the three part arrangement, ordnance area, and training area. Seventeen of the 18 facilities listed as completed between 1942 and 1944 on current HAFB Real Property records or original drawings appear on the 1943 Post Map in the correct locations (Building 754 is not shown). Thirteen of the buildings are in the Main Base. Building 1079 is in the North Area, Building 754 (75754) was at the Golf Course (it has

Figure 10. 1943 Alamogordo Army Air Field Post Map with investigated WW II building locations highlighted

Figure 10. 1943 Alamogordo Army Air Field Post Map with investigated WW II building locations highlighted (adapted from CE File IE 288).

been demolished), and Buildings 1236 and 1237 are in the Munitions Storage Area. No WW II buildings remain in the West Area, although four concrete pads documented in 1994 may represent the foundations of early buildings (HAR-040/LA 105442) (O'Leary 1994b:49-57). The Jeep Target, remains of a skeet range, and a variety of other features associated with training have also been documented as an archaeological site in what is currently known as the Prime Beef Training Area (HAR-082/LA 104440) (Michalik 1994:12-25).

The Cold War had a direct impact on the base layout and building types. Probably the most noticeable build-up involved development of isolated facilities outside and north of the original three part cantonment in what is called the "Supplemental Area" or "near-in area" (Department of the Air Force 1986:13; Dynalectron Corporation 1964) (Figures 11 and 12). Most these remote facilities, constructed between 1947 and the early 1960s, were associated with early Cold War missile testing and development and needed to be away from the heavily populated cantonment for safety and security reasons. These facilities included missile and rocket complexes, such as the Missile Test Stands Area and Able 51, High Speed Test Track, Aeromedical Field Laboratory, and missile test stands associated with the proposed Atlas and ICBM programs. In support of the programs, individual communications and instrumentation facilities were scattered throughout the entire Supplemental Area and into WSMR. Some of the architecture of early rocket test facilities, for instance the missile theodolite towers, are rumored to be of German design from imported scientists although no direct evidence of this has been located.

By 1952, the base had spread to the south with the development of housing that was probably related to the National Housing Act (Wherry-Spence Act) of 1949. This act was in response to a chronic housing shortage suffered by most military bases, including HAFB, after WW II (see Culbertson 1972 for more information on housing). The base continued to expand in 1967 with more housing and a fuel area in the Main Base and expansion of the West Area. This construction was probably related to the military build-up during the Vietnam War and the adaptations by the Air Force to the political/military policy of Flexible Response. Expansion slowed through 1985, but by 1994 the base had been enlarged with substantial growth to the West and North areas to accommodate Bare Base and development associated with the 4th Space Warning Squadron. This last surge was linked to the Carter and Reagan administrations' requirements for C^3I improvements and the major modifications necessary for the Stealth fighter beddown at HAFB (Lewis and Staley 1994:16-20).

The range of facility types for each era falls into a few functional categories (see Table 6). All 18 WW II facilities and one Cold War building (Building 322) are within the first three property types: Operational and Support Installations (n=8), Combat Weapons and Support Systems (n=7), and Training Facilities (n=4). These facilities, with the exception of the Jeep Target, are within the Cantonment Area and

Figure 11. Existing and proposed Cold War complexes in the southern part of the HAFB Supplemental Area, post-1947

Figure 11. Existing and proposed Cold War complexes in the southern part of the HAFB Supplemental Area, post-1947. The WWII Jeep Target Area is also shown (adapted from Weitze 1997:90).

Figure 12. General facility locations with various other Cold War complexes in the HAFB Supplemental Area

Figure 12. General facility locations with various other Cold War complexes in the HAFB Supplemental Area (adapted from Mattson and Tagg 1995:18).

illustrate the types of buildings that could be continually reused through time as the base mission changed, such as administrative and storage buildings in the Cantonment Area and aircraft maintenance buildings along the flight line. All but one of the 15 Cold War facilities fall within the Material Development group and are located in the Supplemental Area. This cluster reflects the bias used in selecting the facilities for inclusion in this study. The general location of the 34 facilities is illustrated on Figure 12 and detailed location maps are in Appendix C.

The remainder of the report will discuss these 34 facilities within the four functional groups. No Intelligence Facilities were included in the assessment. Each section will begin with available background history on the types of facilities, as well as some individual building history if available. The facility descriptions, most of which are taken from the facility assessment forms, include discussion of the earliest known layout, original construction data and functions through time (from Real Property Accountable Records), any modifications to the original construction, and historic integrity. A photograph or drawing is included for each facility, using historic photographs or original drawings if available. The actual building assessment forms are on file at HAFB and are included in the second volume of this report. If applicable, portions of the facility description have also been taken from secondary references (such as Mattson and Tagg 1995).

PROPERTY TYPE I: OPERATIONAL AND SUPPORT INSTALLATIONS

The eight Operational and Support Installations include one Cold War and seven WW II buildings. These facilities fall under the subcategories of Housing (Building 218), Storage (Buildings 71, 96, and 754), Recreation (Building 322), Industrial (Building 302), and Administration (Buildings 200 and 205). Industrial and Administration are WW II categories added because there were no Cold War counterparts. The WW II category for Housing is Residential (Whelan et al. 1997:15-16). The seven WW II buildings are listed in HAFB Real Property Accountable records as being constructed in 1943. With the exception of Building 754 on the Golf Course, the buildings are in the

Main Base and are illustrated on the 1943 Post Map (see Figure 10). The Cold War facility, Building 322, is also in the Main Base, but because it was not constructed until 1949, it is not shown on the 1943 map. Its general location is shown on Figure 12.

The WW II buildings would have been used in a variety of support functions for the aircrew trainees and numerous base personnel, 4,649 of whom were stationed at AAAF in January 1943 (Vandiver 1996:2). The types are self-explanatory: most installations had many buildings for administrative functions, housing for both military and civilian personnel, and storage for a wide variety of items. The Industrial category includes properties associated with "the assembly, production, or repair of war materiel. . ." including

". . . repair shops for routine maintenance of installation equipment" (Whelan et al. 1997:15-16). The Cold War building was a recreation facility used to keep morale up. Of the extant buildings, five are currently in use, although only one storage building (Building 96), is being used for its original purpose. Buildings 200, 599, and 754 were demolished soon after they were documented.

Housing (Residential): Building 218

Housing shortages were a continuing problem from the establishment of AAAF in 1942 to the end of the war. Much of this problem can be attributed to the location of the base, which in 1942 was far from any city of notable size. Alamogordo, with a population of 3,950 in 1940, was wholly unprepared for the influx of military personnel who descended on the area before appropriate accommodations were constructed on the base. The first contingent of soldiers arrived at the base in April and May 1942 and were quartered in a warehouse with only flashlights and gasoline lanterns for lighting. As more personnel followed, a large number of barracks and prefabricated hutments were constructed. The barracks were described as 20' x 100' TO temporary structures with tar paper-covered exterior walls and a life expectancy of five years (Figure 13). About 180 of these units housed military personnel; a third of these were assigned as bachelor officers' quarters and the remainder were for enlisted men. The hutments were also used for officers, but chiefly for enlisted personnel. These buildings were built of plywood and measured 16' x 16'. The general quality of this housing was typical of wartime training bases in the United States, although the high number of officers' quarters reflected AAAF's function as a training center for bomber crews (Holloman Air Development Center [HADC] [1957]:2-7). Construction styles were also typical. During the war, most barracks were built using temporary construction, although some built during the mobilization period used permanent materials (Whelan et al. 1997:16).

Figure 13. Typical theater-of-operations (TO)-type temporary structure at AAAF, "Alta Vista Civilian Housing, Girl's Dorm"

Figure 13. Typical theater-of-operations (TO)-type temporary structure at AAAF, "Alta Vista Civilian Housing, Girl's Dorm" (Alamogordo Army Air Base [1942]).

Many specialized living quarters were also erected. Two slightly larger barracks of "more solid mobilization type" were constructed for the Women's Army Corps (WAC) (listed as WAAC on the 1943 Post Map) (HADC [1957]:7). Other specialized facilities included a guest house of the more conventional barracks type near the hospital to accommodate family members visiting sick personnel, two separate nurses' quarters of nonpermanent construction, and special dormitories for civilian employees. The WAC housing and Subdepot area of civilian quarters are illustrated on the 1943 Post Map, as is the Colored Area for black soldiers (see Figure 10). The isolation of women and blacks on the base illustrates the segregation policy in effect in the armed forces during the war. In 1943, a large scale public housing development exclusively for civilians and their families was constructed near the main entrance road to the base (the Monista Housing Area) by the Federal Public Housing Authority under the Lanham Housing Act of October 1940 (as amended in 1942). This act provided that housing units must be of temporary construction whenever there was no assurance that permanent units could be disposed of at the end of the emergency for which they were built. As a result, 40 buildings with 240 individual family units were constructed. Unlike the hutments for military personnel, these units had both bath and cooking facilities. The housing project also included two dormitories, a cafeteria, a community center, and a commercial facilities building. The development eventually was used for military personnel. No additional family housing units were constructed after the Monista project. Instead, in the last few months of the war, house trailer sites were established to cope with the family housing problem (HADC [1957]:7-11).

The housing problem became worse toward the end of the war when in August 1945, AAAF was used as a processing station to demobilize military personnel returning from overseas. Both the gymnasium and auditorium were converted into temporary dormitories and 200 tents were pitched on the physical training field. By September, this problem had ceased and the military and civilian strength of AAAF fell rapidly. Housing units closed, including the WAC facilities, guest house, and between 200 and 300 barracks and hutments. Many were destroyed by fire, wind, and rain, presumably because of neglect of the abandoned buildings. Although base activities increased with involvement with WSPG and missile testing, 155 hutments were disposed of as surplus in 1947 (HADC [1957]:13-19). Even a few years after WW II, it is obvious that the many temporary housing units on the base had begun to disappear.

Building 218

Building 218, located in the central part of the Main Base, was a temporary facility completed ca. 1943 as an Airmen Dormitory (see Figure 10 and Appendix C). The building is one story with a long, rectangular footprint, an offset at the center of the rear (southeast) elevation, and a low, gable roof (Figure 14). Original construction consisted of asbestos cement shingles on gypsum sheathing and a wood frame. The roof was slate, the floor wood and mastipave, and the foundation concrete piers on isolated footings. The

Figure 14. Building 218 as the Thrift Shop in 1996, northwest and southwest elevations

Figure 14. Building 218 as the Thrift Shop in 1996, northwest and southwest elevations.

building was originally listed as being 20' x 100' in size (although this number is crossed out and 20' x 110'6" is written in). It had a 10' square offset (entryway) with 2,000 square feet (SF) of interior space.

In 1968, 310 SF were added, bringing the total space to 2,310 SF. Listed functions for the building include Administration/Supply and Issue/Organization (ca. 1959), Administrative Office (n.d.), Audio Visual Facility (ca. 1969), Air Base Headquarters Group (n.d.), and Non-Air Force Administrative Office (ca. 1988). It has been used since 1995 as the Thrift Shop (Real Property Accountable Form/218; Facility Assessment Form/218). The earliest existing drawing (1986) shows the building as being 20'6" x 110'8" with the 10'1" x 10'3" enclosed entryway at the center of the southeast elevation (Figure 15). Three doors are illustrated, one each at the northeast, northwest, and southeast (within the offset) elevations. Twenty windows are shown at the northwest and southeast elevations, with one at the southwest elevation. There are no interior partitions. No original drawings were located and neither the architect nor builder is known (Facility Assessment Form/218).

Building 218 appears to have been one of the 20' x 100' TO-type temporary structures originally constructed to house military personnel in 1943 and is the only remaining WW II housing unit on HAFB. The building retains its original rectangular footprint, single story scope, and gable roof profile, although it no longer retains historic integrity due to extensive architectural modifications. All original doors and windows have been replaced and one window opening has been framed in. At the northwest (principal)

Figure 15. Building 218 floor plan, probably as an Air Force Headquarters Group or Administrative office, ca. 1986

Figure 15. Building 218 floor plan, probably as an Air Force Headquarters Group or Administrative office, ca. 1986.

elevation, double glass doors and a handicap ramp and railings replaced a single door and concrete stair landing, and emergency exit doors are at the northeast and southeast elevations. Slider windows are symmetrically placed at both the northwest and southeast elevations. The original exterior siding has been removed and replaced with lath and stucco over the wood frame. The roof now has asphalt shingles and the foundation is a continuous concrete stem wall footing. Alterations to the interior could not be determined without original drawings (Facility Assessment Form/218).

The building is located along the primary Main Base road in an area that once had a group of identical structures (see Figure 10). Only Building 205, another WW II facility described below, remains. The other contemporary buildings once in the vicinity, as well as all other housing units on the base during the war, are gone. Building 218 has undoubtedly been used continually since its construction in 1943 and, therefore, because of the upgrading necessary to keep this temporary five year building in use for 50 years it retains no visible element links to its original use as an Airmen Dormitory.

Storage: Buildings 71, 96, and 754

Little can be said about storage facilities on the base other than as with any operational organization, there is always a need for buildings to house goods and equipment. It is unknown what was stored in the three WW II storage facilities described here, with the possible exception of Building 71. No original drawings exist for these buildings; the original uses and construction specifications are taken from the Real Property Accountable Records.

Building 71

Building 71, located in the east-central part of the Main Base, was originally constructed ca. 1943 as a semipermanent Civil Engineer covered storage facility (see Figure 10 and Appendix C). It is a one story structure showing a split elevation gable roof at the principal (northeast) facade, with shed and gable roofs at the offsets (Figure 16). The building is rectangular with offsets at every elevation except the southeast and fenestration is symmetrical. Original construction was asbestos shingles on wood frame walls with an asphalt roll roof (slate was originally written on the Real Property form but is crossed out). The foundation consisted of concrete wall footings and a concrete slab and the floor was concrete. The building was 55' x 89' with a 19' x 25' offset, a 10' x 16' heater room, and an 8' x 10' generator room. It had 5,370 SF of interior space; 240 SF were added in 1966 for a total of 5,610 SF. Listed functions for the building include Base Food Cold Storage (ca. 1953), Administrative Office (ca. 1965), and Base Engineer Administration (n.d.). It is currently used as the Family Housing Management Office (Facility Assessment Form/71; Real Property Accountable Record/71).

Figure 16. Building 71, as the Family Housing Management Office in 1996, northwest and northeast elevations

Figure 16. Building 71, as the Family Housing Management Office in 1996, northwest and northeast elevations.

The earliest drawing located for the facility was completed in 1953 when the building appears to have been the Base Food Cold Storage structure. Buildings 71 and 72 are shown connected by a 79'6" long meat rail and cover an area of 121'9" x 164'2" (Figure 17). Building 71, the northern (main) building, was roughly rectangular, 108'1" x 54'9" in size, with two double-hung doors at the northeast elevation, a double- and two single-hung doors at the northwest elevation, and a single-hung door at the southwest elevation. The double doors at the northwest elevation opened into a hallway and open area with partitioned rooms around the edges and what appears to have been two meat rack rooms in the center. The doors at the northwest and southwest elevations opened into small offsets. Building 72, the southern wing, was roughly T-shaped, measured 39'10" x 121'9" in size, and exhibited single-hung doors on the west and north elevations. The interior was divided into rooms of various size. Two windows are shown at a small offset at the northeast elevation and four each are symmetrically placed at both meat rail elevations. No original drawings were located and neither the architect nor builder is known (Facility Assessment Form/71).

Figure 17. Building 71, floor plan of Base Food Cold Storage facility when it was attached to Building 72, ca. 1953

Figure 17. Building 71, floor plan of Base Food Cold Storage facility when it was attached to Building 72, ca. 1953.

Building 71 currently retains its original single story scope, rectangular footprint with offsets, and split elevation gable and shed roofs; it is no longer connected to Building 72. The building does not retain historic integrity due to extensive alterations to the floor plan and elevations since its completion. In 1966 the building was expanded to 5,610 SF and it may have been completely remodified at this time. A 1978 drawing for the building shows it as roughly rectangular with dimensions of 55' x 108'. This floor plan indicates additions to the northwest (10' x 17' heater room), southwest (7' x 10' generator room), and northeast (6' x 8'). Another 1978 drawing shows five offsets of 8' x 16', 6'8" x 10', 4'5" x 5'2", 6' x 16'6", and 16' x 25'6". All windows and doors have been modified: at least seven windows openings have been framed in and sided over; seven windows have been replaced with different types; and six doors have been replaced with different styles. An exterior insulation and finish system was added in 1984, asphalt shingles replaced the original roofing, and aluminum canopies were constructed over the front and rear entrance doors. Because of these modifications, no exterior design elements remain. The addition of interior partitioning and finishes obscures the original interior (Facility Assessment Form/71; Real Property Accountable Record/71).

Building 71, as shown on the 1943 Post Map, was a rectangular building located near the Utility Yard and Motor Pool in an area of identically shaped buildings (see Figure 10). This implies that it was attached to Building 72 with the meat rail at a later time. Building 72, and all of the other adjacent buildings from WW II, no longer remain in the area. Building 71 has undoubtedly been used continually since its construction in 1943 for purposes other than what it was constructed for. Because of the extensive alterations necessary to change the building from a storage building to a refrigerated food storage facility, and then to an administrative facility, it retains no visible element links to its original shape or use.

Building 96

Building 96, located in the east-central part of the Main Base near Building 71, was a temporary facility originally constructed in 1943 as a Base Warehouse (see Figure 10 and

Appendix C). It is a long, single story, gable roof structure with a rectangular footprint (Figure 18). The principal elevation faces northeast. The building was originally constructed of wood frame with asbestos shingle walls on a concrete foundation, a concrete floor, and either slate or roll roofing. The building was listed as 50' x 192', with internal space of 2,114 SF. It has always functioned as a storage facility, with the only interim function listed as Warehouse, Supply and Equipment, Base (n.d.). It has been used since 1975 as a Supply and Storage Facility for Housing (Facility Assessment Form/96; Real Property Accountable Record/96).

The earliest drawing (1951) shows the 50' x 192' building with an unpartitioned interior (Figure 19). It had four double equipment doors and at least eight windows on both the northeast and southwest elevations,

Figure 18. Building 96 as the Housing Supply and Storage facility in 1996, northwest and northeast elevations

Figure 18. Building 96 as the Housing Supply and Storage facility in 1996, northwest and northeast elevations.

and four windows each at the northwest and southeast elevations. Another early drawing shows four double wooden equipment doors and one single wooden personnel door and at least 19 six-ligh windows. The southwest elevation faces an abandoned Cold War-era railroad track. No original drawings were located and neither the architect nor builder is known (Facility Assessment Form/96).

Building 96 retains its original rectangular footprint, single story scope, and gable roof profile, although most of the original architectural features and finishes have been replaced, removed, or obscured. Between 1951 and 1991, at least two extensive renovations occurred at the interior and exterior. The 19 six-light windows have been removed from the southwest and northeast elevations and wood equipment doors have been replaced with roll-up metal doors. An exterior insulation and finish siding system (stucco) replaced

Figure 19. Building 96, floor plan as a Base Warehouse, ca. 1951

Figure 19. Building 96, floor plan as a Base Warehouse, ca. 1951.

the original asbestos shingle siding. The original roll or slate roof has been replaced with asphalt shingles. The foundation is a continuous concrete stem wall footing. Access was not gained to the building, so interior alterations could not be determined (Facility Assessment Form/96).

The building was located near the WW II Motor Pool in a block of identically shaped buildings, none of which remain today (see Figure 10). It now sits adjacent to a railroad track built in 1954 to bring supplies into the base during the Cold War. Apparently, numerous warehouses once lined the tracks in this locale (Diana Moya, HAFB Real Property Manager, personal communication 1997). Although Building 96 has retained its storage use since construction in 1943, nearly all of the original workmanship has been removed or obscured. The building does retain some aspects of its utilitarian design and use as a warehouse facility, as well as its location beside a Cold War railroad (Facility Assessment Form/96).

Building 754

Building 754, located west of the golf course, was originally constructed in 1943 as a permanent Base Engineer Storage shed (see Figure 10 and Appendix C). The building was recently renumbered as Building 75754. It was one story with a rectangular footprint and a gable roof (Figure 20). The principal facade faced east. The building was constructed with a concrete foundation and floor, exterior walls of wood and asbestos, and either a slate or asphalt roll roof. The original building was 18' x 21', with a 20' x 51' addition. The interior space was 378 SF, with subsequent improvements through 1957 adding 1,020 SF to increase the size to 1,398 SF. Listed functions for the building include Base Storage shed (n.d.), Base Warehouse Supply and Equipment (n.d.), Base Engineer Covered facility (n.d. and 1976), and Base Engineer Paving and Grounds facility (1978). The building last functioned as a miscellaneous outdoor recreation facility for storage at the golf course, possibly being used for that function since 1990 (Real Property Accountable Record/75754). It was demolished in 1997.

A drawing completed for the current project (1996) showed the building as 21'9" x 71'4" in size (Figure 21). The southern section of the shed was two feet wider than the northern section. The structure had four rooms. The larger central room, for tractor machinery, was accessed by two sliding doors providing an 18' opening. One end room was also accessed by two sliding doors. A single personnel door at the opposite end accessed employee break and computer rooms. The remaining elevations showed 10 double-hung windows evenly spaced across the face of the building. No construction drawings of this building were located and neither the architect nor builder is known (Facility Assessment Form/754).

At the time of the assessment, Building 754 maintained its original rectangular footprint, single story scope, and gable roof profile, although it no longer retained historic integrity due to extensive alterations

Figure 20. Building 754 as a Golf Course storage facility in 1996 prior to demolition, north and east elevations

Figure 20. Building 754 as a Golf Course storage facility in 1996 prior to demolition, north and east elevations.

since its original construction. The building was continuously improved from its completion date through 1957. The foundation was slab-on-grade and the exterior walls were asbestos siding on 1x sheathing with two layers of gyp board on wood studs. There was a roll roof on tongue and groove sheathing supported by wood rafters (Facility Assessment Form/754). The original location of the building is unknown because it is not illustrated on the 1943 Post Map, and there are indications that it was moved from its original location. According to Diana Moya (personal communication 1997), the land on which Building 75754 sat was not acquired by the Air Force until 1955 and the golf course was constructed in 1958. This section of land is also not shown within the base property lines on the 1943 Post Map; the only 700 series buildings shown on this map are in the W.A.A.C. Area of the Main Base (Buildings 780-783). A notation on the Real Property Accountable Record reads “relocation-services” with a date of 4 December 1957. These data imply that the building was no longer where it was originally constructed. The recent demolition of the building removes it from further management consideration.

Recreation: Building 322

Lack of water, along with available housing, has been a major problem since the inception of the base in 1943. Consequently, the construction and use of swimming pools on the base was a controversial issue. Preliminary planning for the proposed military installation some 10 miles from the small town of

Figure 21. Building 754, floor plan of Golf Course storage building in 1996

Figure 21. Building 754, floor plan of Golf Course storage building in 1996.

Alamogordo involved an investigation of water resources. When the base was under construction, water was brought from Alamogordo by truck for construction and drinking purposes. In 1942, a 5 inch diameter water line, replaced in 1943 by a 10 inch pipe, was run to the base from town. The following year the intake from the Alamo Canyon system fell off noticeably, demands rose, and the lack of water became a problem. On the part of the USAAF, water was needed for servicing aircraft and such special facilities as the swimming pool. The official justification for the latter was that airmen, who might later be forced down over an ocean, should have a training tank in which to practice disentangling themselves from their parachutes under realistic conditions. The main water requirement, however, was for domestic uses such as bathing, cooking, and so forth (Bushnell [1957]:7-9).

In 1944, when base water consumption was exceeding 600,000 gallons per day, AAAF launched a water conservation program. Lawn watering was limited to evening hours, water fountain use was restricted, and the swimming pool training area was closed. In addition, airplane washing was suspended, the use of evaporative coolers was forbidden or restricted, and the use of hot water for showers was temporarily forbidden lest personnel be tempted to spend too much time bathing. The USAAF developed alternative sources of water to help alleviate the problem, such as using effluent from the base sewage disposal plant for compaction during road construction and developing a well adjacent to the swimming pool for the express purpose of pool use. Water from the swimming pool well was not recommended for drinking and was described as unusually bad water, good only for putting out fires, settling dust, and in swimming pools. All vegetation around the pool was killed by the water splashing out (Bushnell [1957]: 11-13).

With the decline of the base population after the end of WW II, the water shortage abated and personnel on the base no longer had to swim in brackish water from the pool well. Fresh water from the town supply was once again used for the pool. In 1947, however, AAAF was transferred to AMC for use in the Air Force missile program and immediately there was a revival of the water problem. The base population did not reach the levels seen during WW II, but there was a substantial increase which strained the shaky water supply. The missile program also had special demands for water. Actual launchings and static firings posed fire hazards and required a large water supply for fire fighting and prevention. The use of toxic fuels meant water was needed for drenching the test and launching facilities after firing. For example, the Nativ missile had a minimum requirement of 3,000 gallons of water per minute for five minutes to wash down the launch tower after every launch. Each sled run on the HSTT required thousands of gallons for operation of the water brakes on sleds (Bushnell [1957]:18-21).

Serious consideration was given to the treatment of saline well water but no program was initiated. The swimming pool well was no longer in use. Instead, swimmers continued to enjoy water from the main lines and the use of tap water for swimming was even extended with the construction of a new pool for airmen in 1949 (associated with Building 322). The old pool was then assigned to officers. Both pools were equipped with complete facilities for filtering and recirculating the water, thus keeping water use to the lowest level possible (Bushnell [1957]:31). With the addition of water wells on the Boles farm, and finally a pipeline from Bonito Lake near Ruidoso, water problems seemed to be at least partially solved.

Building 322

Building 322, located in the central part of the Main Base, was a permanent building originally constructed in 1949 as a Swimming Pool Bathhouse (see Figure 12 and Appendix C). It is the only Cold War building not included in the Materiel Development Facilities category. The building deserves special mention for two reasons. It has a commemorative plaque mounted on the front wall, and the construction of the swimming facility apparently created a minor controversy because of the chronic water shortage in the area.

Building 322 is a single story, flat roof concrete building with a rectangular footprint (Figure 22). The building was originally constructed of a reinforced concrete frame with concrete masonry unit (CMU) wall infill and had a concrete floor. It had a built-up roof on a concrete slab. The foundation consisted of a reinforced concrete slab with isolated column footings. The building is listed as being 39' x 88' (27' x 69' main building with two 12' x 18' offsets) with 2,295 SF of interior space. There have been no interim functions and the building apparently was used for its intended function until ca. 1992 when it became a Miscellaneous Recreational Facility/Arts and Craft Center and was used for storage. In 1997 the showers were repaired and the building was reclassified as a Recreation Center/Health and Wellness Center (Diana Moya, personal communication 1998; Facility Assessment Form/322; Real Property Accountable Record/322).

An original 1948 drawing of the building shows it as 39'3" x 68'8" in size with two offsets measuring 17'7" wide (Figure 23). These offsets extended from the southeast elevation, and the building exhibited symmetrical fenestration and a beveled concrete soffitt. The principal facade faced southeast. Six single-hung doors were at the northwest elevation, shielded from the pool by a privacy wall. Two doors each accessed small rooms at the northwest and southeast (principal) elevations and two single-hung doors were at the southwest elevation. Various sized windows were situated at all but the northeast elevation, including privacy windows placed near the eaves. The interior included a variety of large and small rooms on each side of a narrow hallway representing dressing, shower, and rest rooms. A swimming pool, Facility 321, was located about 26 ft to the northwest of the bathhouse. The pool measured 63' x 82'2" and ranged in depth from 4' to 13'. An 11' square wading pool was located just south of the pool.

Figure 22. Building 322 as a Miscellaneous Recreational facility/Arts and Craft Center in 1996, southeast elevation

Figure 22. Building 322 as a Miscellaneous Recreational facility/Arts and Craft Center in 1996, southeast elevation.

A 48' long privacy wall abutted the bathhouse, separating access doors from direct vision of the pool (CE File 321-4/IE 878; Facility Assessment Form/322).

Twenty-three original drawings for this building were located, and it appears to have been constructed as originally designed. The drawings were prepared by the Department of the Army (Washington, D.C.). Although neither the architect nor builder is known, Russell and Axon (Daytona Beach, Florida and St. Louis, Missouri) provided the engineering consultation (Facility Assessment Form/322). A plaque is mounted at the principal (southeast) elevation and reads, “The construction of this swimming pool by military personnel of WW II as a memorial to their comrades who gave their lives in that war." This commemorative plaque implies that the building was constructed by WW II veterans.

Building 322 was the bathhouse for the new airmen's pool. The building retains almost all aspects of its original design elements such as the rectangular footprint (with offsets), single story scope, flat roof profile, chamfered concrete cornice, privacy windows, and exterior water fountain. At least two three-panel metal doors have been replaced, privacy walls and a canopy at the northwest elevation removed, and minor alterations occurred at the interior such as removal of metal turnstiles and clothing bins.

Figure 23. Building 322, floor plan of Swimmer's Bathhouse, ca. 1948

Figure 23. Building 322, floor plan of Swimmer's Bathhouse, ca. 1948.

The metal frame, hopper-style windows appear to be original, although numerous panes have been replaced. Access was not gained to the building so it is unknown if interior features remain intact. The associated swimming and wading pools were filled in on 21 September 1992. The viewshed has altered considerably with the demolition or renovation of contemporary buildings, construction of new buildings, and the addition of the static aircraft display across the street (Diana Moya, personal communication 1997; Facility Assessment Form/322).

Building 322 represents a local example of a prototypical Department of the Army bathhouse design, although it is an ancillary structure and does not exhibit distinctive design characteristics or workmanship. It appears to have functioned for its original use except for a five year period between 1992 and 1997, and continues to exhibit features unique to its function as a bathhouse (Facility Assessment Form/322). The building also represents a memorial to those military personnel who gave their lives in WW II, although further research will be necessary to determine the history behind the plaque.

Administration: Buildings 200 and 205

All installations would have had numerous buildings that housed administrative functions necessary to run an organization. These would include headquarters and administrative groups handling the everyday management of the base and personnel paperwork such as in- and out-processing, pay, equipment management, training schedules, etc. Whelan et al. (1997:15) include in this category administration buildings, guard houses, gate house or sentry boxes, fire stations, post offices, and headquarters offices. Two administration offices from WW II were assessed during this project.

Building 200

Building 200, located in the central part of the Main Base, was a semipermanent facility originally constructed ca. 1943 as an administrative office (see Figure 10 and Appendix C). It was a single story, gable roof structure with asymmetrical fenestratration and a rectangular footprint (Figure 24). The principal facade faced northeast. The building was constructed originally with a wood frame and wood drop siding, isolated concrete pier footings and a wooden floor, and asphalt roll roofing. The building is listed as being 25' x 112' with a 12' x 20' offset and 2,968 SF of interior space; an addition of 72 SF in 1963 increased the floor space to 3,040 SF. Notable interior features included steam radiators. Listed functions for the building included a Service Outlet Exchange (ca. 1963) and the Thrift Shop (n.d.). The building was functioning as the Thrift Shop when it was determined to be in a poor state of repair and was abandoned in 1995. It was demolished in January 1997 (Facility Assessment Form/200; Real Property Facility File/200).

Figure 24. Building 200, the abandoned Thrift Shop in 1996 prior to demolition, northwest and northeast elevations

Figure 24. Building 200, the abandoned Thrift Shop in 1996 prior to demolition, northwest and northeast elevations.

The earliest drawing for the building (1986) shows a rectangular building (25'8" x 111'3") with a 12'2" x 19'6" offset at the southeast elevation (Figure 25). Four single-hung doors with concrete stair landings were on the southwest (n=1) and northeast (n=3, principal) elevations and a fifth single-hung door provided access to the offset. One of the doors entered into a small room, the only partition shown at the interior. Although original construction drawings were not located, the Real Property Accountable Record indicates the building was constructed as a wood frame mobilization unit. Neither the architect nor builder is known (Facility Assessment Form/200).

Figure 25. Building 200, floor plan as Service Outlet Exchange or Thrift Shop, ca. 1986

Figure 25. Building 200, floor plan as Service Outlet Exchange or Thrift Shop, ca. 1986.

At the time of the assessment Building 200 retained its original rectangular footprint, single story scope and gable roof profile, although it did not retain historic integrity. Extensive remodeling had obscured most of the original elements of design, workmanship, and materials, although the original wood frame structural system appeared intact. Hollow metal doors and aluminum frame windows replaced original wooden architectural features and at least one door and a number of windows were removed and the openings filled in. An exterior insulation and finish siding system (Dryvit®) was attached to the original wood siding and trim was removed. Vinyl floor tile was overlaid with asphalt tile and wood wainscoting and chair rail were added. Wooden stairs were replaced with concrete landings. A concrete stem wall was added and asphalt shingles replaced the original roll roofing. Floor finishes and interior trim were also added (Facility Assessment Form/200).

The building was located along the primary Main Base road in an area that once had a group of identical structures (see Figure 10). The other contemporary buildings once in the vicinity, including Building 206 which appears to have been connected to Building 200 by a sidewalk, are gone. Building 200 was undoubtedly in continual use after its construction in 1943. Without original blueprints it was difficult to make a determination on structural integrity, but the most recent exterior finishes appeared to be relatively new. The recent demolition of the building has removed it from further consideration.

Building 205

Building 205, located in the central part of the Main Base, was a semipermanent facility originally constructed in 1943 as an Administrative Office, Headquarters Division (see Figure 10 and Appendix C). It is a two story, rectangular, asymmetrically fenestrated, gable roof structure (Figure 26). The building was constructed originally of a wood frame with asbestos shingles on a concrete foundation. The building had roll roofing on wood and a wood and concrete floor. It is listed as having a 69' x 99' first floor, a 46' x 99' second story, and offsets of 5' x 6' (entryways), 15' x 22' (mechanical room?), and 16'6" x 17' (vault). The original floor space is listed as 7,161 SF, with modifications through May 1957 increasing that amount to 11,855 SF. The final floor space after the removal of an 8' x 10' lean-to (December 1960) and addition of 261 SF (February 1961) is 12,056 SF. Listed functions for the building include Air Base Headquarters Group (ca. 1972) and 833rd Air Division Accounting and Finance Office (ca. 1985). The building has functioned as the Base Recreation Library since 1989 (Facility Assessment Form/205; Real Property Accountable Record/205).

The earliest drawing (1959) shows a 69'7" x 99'2" building with a vault and mechanical room projecting from the building at the northeast elevation (15'6" x 16' and 15'6" x 20', respectively), another small offset at the southeast elevation, and enclosed entryways extending from the northwest and southeast elevations

Figure 26. Building 205 as the Base Library in 1995, southeast and northeast elevations

Figure 26. Building 205 as the Base Library in 1995, southeast and northeast elevations.

(Figure 27). These offsets have low shed or flat roofs. The principal facade faces southeast with access gained through a double-hung (currently single-hung) personnel door. Double-hung doors are also located on the northwest and southwest elevations and at the mechanical room. The floor plan shows a hall bisecting the structure with numerous rooms of various size on either side. A stairway inside, and another above the main entry door outside (not illustrated on the drawing), provide access to the second story. Original construction drawings were not located and neither the architect nor builder is known (Facility Assessment Form/205; Real Property Accountable Record/205).

The rectangular footprint, two story scope, and gable roof profile still remain for Building 205, although it does not retain historic integrity. Structural modifications include at least three renovations to the exterior walls and openings between 1960 and 1989. Extensive architectural and minor structural modifications have resulted in the removal of at least 31 windows and six exterior doors. At least 10 windows appear to be replacements, measuring in some cases 2 ft narrower than those shown on the earliest blueprints. Security grill work at the windows may have been added during the use of this building as a financial

Figure 27. Building 205, floor plan as a possible Administrative Office, Headquarters Division, ca. 1959

Figure 27. Building 205, floor plan as a possible Administrative Office, Headquarters Division, ca. 1959.

facility. The original framing and siding systems are obscured by an exterior rigid insulation and spray-on cementous coating finish over CMUs. Asphalt shingles replaced the original roll roofing and the foundation is now concrete grade beam. At the interior, partitions have been removed and an interior bearing partition added. An acoustical tile ceiling has also been added and the walls covered with gypsum panels. A 16'6" x 17' reinforced concrete vault with a thick steel door was removed from Building 29 and installed in Building 205 in 1960. A cashier's cage, also removed from Building 29 and installed in Building 205, has been removed (Facility Assessment Form/205).

The building is located along the primary Main Base road in an area that once had a group of dormitories such as Building 218, described previously (see Figure 10). With the exception of that building, other contemporary buildings in the vicinity have been demolished. Building 205 has undoubtedly been in continual use since its construction in 1943. Modifications to facilitate the changing pattern of use over the past 50 years have resulted in a distinct loss of historic integrity in terms of design, setting, materials, workmanship, and association (Facility Assessment Form/205).

Industrial: Building 302

The Industrial category is defined as "Properties associated with the assembly, production, or repair of war materiel" (Whelan et al. 1997:15). On training bases such as AAAF, this would include maintenance and repair shops for routine upkeep of installation equipment and facilities. Normally, the Civil Engineer Squadron has this responsibility: one Base Engineering Shop from WW II was assessed.

Building 302

Building 302, located in the central part of the Main Base just southeast of the runway, was constructed ca. 1942. It was originally listed as a General Purpose Aircraft Shop, although "As Constructed" blueprints indicate it was designed as a Base Engineering Shop (see Figure 10 and Appendix C). It is listed as being a permanent building, although a 1994 HAFB map shows Building 302 as being semipermanent. The building is irregularly shaped and one story, showing two gables each at the northwest and southeast elevations (Figure 28). The building was constructed originally of wood siding on sheathing attached to 2" x 4" studs 2" on center. The foundation was constructed using a concrete wall and isolated footings. The floor was concrete and the roof was built-up on 1x diagonal sheathing supported by 2" x 8" purlins on trusses. Notable interior and exterior features included quadrangle Howe-type roof trusses, wood gutters, and wood louvers. The building is listed as being 152' x 156', with a second size listing of 11' x 121', and offsets of 40' x 81' (possible 1964 addition), 20' x 50', and 20' x 54' (original offset with possible 1966 addition). The original floor space is listed as 26,391 SF. Additions of 3,240 SF (through 1957) and

Figure 28. Building 302 as a Squadrons Operations and Education facility in 1996, southwest elevation

Figure 28. Building 302 as a Squadrons Operations and Education facility in 1996, southwest elevation.

480 SF (1960) and the loss of 348 SF (1965) resulted in a final square footage of 29,763. Listed functions for the building include Aircraft General Purpose Shop (n.d.), Mobile Training Unit (ca. 1963), Field Training Unit (n.d.), Weapons and Release Systems Shop (ca. 1971), Technical Training Classroom (ca. 1978), Academic Facility (ca. 1988), ADAL (meaning unknown) Aircraft Maintenance Facility (ca. 1988), and Computer Lab/Education Center (ca. 1994). The building currently functions as a Squadrons Operations and Education facility (Real Property Accountable Record/302; Facility Assessment Form/302).

The earliest construction drawings are dated 1941, with As Constructed drawings dated 1942. A 1943 drawing shows a 155'7" x 162' main building with a 20' x 40'6" offset at the southwest elevation (Figure 29). Three 1960s additions are also shown on the northwest and southwest elevations. The main building has a large open shop in the center flanked by smaller rooms labeled as a radiation room, men's and women's locker rooms, showers, work order room, and boiler room. The two gables at the northwest

Figure 29. Building 302, floor plan as the Base Engineering Shop, ca. 1942.

Figure 29. Building 302, floor plan as the Base Engineering Shop, ca. 1942.

and southeast elevations are formed by two truss spans along each elevation. The main facade faces southwest with access gained through a double-hung personnel door. Fenestration at all elevations is asymmetrical with doors and windows of different dimensions and types; doors are at the center of each elevation and windows are at all but the southwest elevation. The original offset had two rooms for metal plating and sand blasting. Nineteen sets of drawings documenting numerous alterations to the original building were located. Neither the architect nor builder is known (Facility Assessment Form/302).

Building 302 is still one story with two gables, although it does not have the original relatively square footprint. The building does not retain historic integrity. At least six floor plan alterations have changed this original engine shop from one central room with surrounding offices into a maze of some 65 rooms and offices located on either side of central corridors. Improvements began in 1944 with additions along the north and south elevations. Original elevations showed double-hung windows positioned symmetrically along each long elevation. These original windows, as well as original doors, were removed on at least two separate occasions in 1964 and 1966. Aluminum vertical siding was added, possibly attached to the original sheathing, in 1966. A 4" to 5" concrete topping has been added to the original floor (Facility Assessment Form/302).

The building is located within the central Main Base along the runway amid aircraft maintenance shops and hangars (see Figure 10). Many of these buildings still exist, interspersed among more modern facilities. The original function of Building 302 is not known, because records listed it as being a General Purpose Aircraft Shop but blueprints show it as Base Engineering Shop. The former function seems more likely considering the location of the facility, although original drawings indicate the latter. Building 302 has undoubtedly been in continual use since its construction ca. 1942. It has been modified from a relatively small, square wood-constructed machine shop to an irregularly shaped, metal clad office building. The original architectural and decorative materials at all elevations, predominantly of wood, have been replaced, altered, or obscured. Except for the original structural frame, nearly all original elements have been lost (Facility Assessment Form/302).

PROPERTY TYPE II: COMBAT WEAPONS AND SUPPORT SYSTEMS

The seven Combat Weapons and Support Systems facilities are all WW II buildings and include four maintenance docks/hangars (Buildings 291, 300, 301, and 1079) and three storage buildings (Buildings 289, 1236, and 1237). These buildings would have functioned in support of the Heavy and Very Heavy bombers used in crew training at AAAF during WW II: the four hangars for aircraft maintenance and the three storage facilities in ancillary roles for storing munitions and flammable materials.

The buildings are listed in HAFB Real Property Accountable records as being constructed in 1943, with the exception of Building 1079 showing a 1944 completion date. The hangars and one storage building are located along the flight line in the Main Base. Buildings 1236 and 1237 are in the Munitions Storage Area to the northeast of the North Area. All of the buildings are illustrated on the 1943 Post Map, although the three storage buildings had different numbers at that time (see Figure 10). Buildings 1236 and 1237 were formerly 1206 and 1208, respectively, and it appears that Building 289 was 286. The fact that Building 1079 is on the map implies it was either constructed prior to the 1944 completion date on the Real Property form or may have been included on the map while it was under construction.

All of the buildings are currently in use and still retain their original functions. Interim functions may have varied, however. For instance, in the late 1940s or early 1950s, Building 1079 was apparently used for assembling missiles and components. A footnote in a HAFB report from 1950 states that the "[p]resent hangar (1079) will be adequate if fully utilized by Northrop Aircraft Inc. Present Aerobee functions now in hangar are being moved to a temporary building" (HAFB 1950: Appendix B-8). Two buildings, 289 and 291, are slated for demolition in 1998.

Maintenance Docks/Hangars (Transportation): Buildings 291, 300, 301, and 1079

Four WW II maintenance docks, or hangars, remain adjacent to the original base runway. The hangars were designed to accommodate a maintenance area for large aircraft, to support vertical engine hoist system loads, and to withstand variations in temperature due to exposure to the elements at the slider doors and the uninterrupted interior space (Facility Assessment Form/301). Three bomber types were used at AAAF: B-17s (May-August 1942), B-24s (August 1942-March 1944), and B-29s (August-September 1945) (Mattson and Tagg 1995:10). The specifications of each bomber are listed in Table 7 to illustrate which hangars could have housed the various aircraft during maintenance. The four facilities were undoubtedly constructed for B-17 and B-24 bombers (Figure 30). They have open space lengths of approximately 112' to 160' and heights to the bottom chord of the trusses of about 22' to 38', which could facilitate both bomber types with wing spans of 110' or less and heights of less than 20'. A B-29, with a wing span of 141', would only fit in Buildings 301 and 1079 and only if the small inset, or cutout, above the center of the sliding doors could be opened for the 28' to 29' height of the plane. Major Otto K. Mueller (USAF, Retired), who trained B-29 combat crews at AAAF in 1944 and 1945, recognized Building 1079 as one of the hangars they used. On a recent trip to the base, he ". . . drove out to the present North Area and . . . there was one of the hangars we flew out of still standing. These hangars can be distinguished by the cutout for the large B-29 tail in the upper portion of the hangar above the hangar doors" (Mueller 1995) (Figure 31).

Table 7
Bomber Specifications

Bomber	Length	Width Wing Span	Height	Crew	Armament	Bomb Load	Reference
B-17	67'10" to 74' 9"	103'9"	19'1" to 19'2"	6 to 10	5 to 13 .30 and .50 caliber machine guns	6,000 to 17,600 lbs	Donald 1995:24; Jablonski 1965:310-311; Taylor 1991:53
B-24	66'4" to 67'3"	110'	17'11" to 18'	10	7 to 11 .30 and .50 caliber machine guns	8,000 to 8,800 lbs	Donald 1995:47; Birdsall 1973:315; Taylor 1991:84-85
B-29	99'	141'3"	27'9" to 29'7"	10 to 14	10 to 12 .50 caliber machine guns and one 20 mm cannon	20,000 lbs	Donald 1995:30; Berger 1976:102; Taylor 1991:64

Figure 30. “Sub Depot Hangar with B-24” at AAAF (Alamogordo Army Air Base [1942])

Figure 30. “Sub Depot Hangar with B-24” at AAAF (Alamogordo Army Air Base [1942]).

Figure 31. “B-29 Flight Engineer Maxwell White on ‘Blue Max.’”

Figure 31. “B-29 Flight Engineer Maxwell White on ‘Blue Max.’” Note open cutout above hangar door with B-29 tail. This hangar may be Building 1079 (courtesy of Major Otto K. Mueller [USAF, Retired]).

Building 291

Building 291 was originally documented and assessed in 1996 for the German Air Force Beddown building demolition project (Ernst et al. 1996). The facility assessment form was updated for the current project. Building 291, located in the central Main Base just southwest of the runway, is a semipermanent building completed ca. 1943 as a Field Maintenance Hangar (see Figure 10 and Appendix C). Originally rectangular in shape with an offset boiler room at the south elevation, additions to the west elevation give the building its current irregular footprint. It has a slightly pitched gable roof (Figure 32). The building was originally constructed of asbestos shingles on 1" thick wood sheathing and wood frame. The foundation was isolated concrete footings supporting steel columns, and a 6" slab. The floor was concrete

Figure 32. Building 291 as a Maintenance Dock for Small Aircraft in 1996, east elevation

Figure 32. Building 291 as a Maintenance Dock for Small Aircraft in 1996, east elevation.

and the roof felt (tar paper) on a wood deck supported by steel purlins. Notable interior features were the large open space and the 1" thick wood wall sheathing and roof decking. The building is listed as being 102' x 151'6" with offsets of 20' square (possibly the boiler room) and 22' x 61' (possibly the new addition). The original floor space was 15,000 SF, with additions of 1,764 SF (through 1957) bringing the total to 16,764 SF. Listed functions for the building include Ground Supply Equipment (GSE) Shop (ca. 1963), GSE Air Ground Equipment (AGE) Shop (n.d.), Small Aircraft Maintenance Shop (ca. 1970), Base Supply and Equipment Warehouse (ca. 1972), AGE Shop and Storage Facility (ca. 1975), and HG (Hangar/Headquarters Group?) Maintenance (ca. 1983). The building has been a small aircraft maintenance dock since 1992 (Real Property Accountable record/291; Facility Assessment Form/291). It is slated for demolition in 1998.

The earliest drawing for the building (1961) shows a 101'6" x 152' footprint with the 20' x 21' boiler room at the south elevation (101'6" x 172') (Figure 33). A double door accessed the boiler room and single-hung doors are at the south (n=2) and north (n=2) elevations. Two offices, one small and one large, flanked both sides of the large, open, steel bay. A later addition to the west elevation increases the building dimensions

Figure 33. Building 291, floor plan as a probable Maintenance Dock for Small Aircraft, ca. 1961

Figure 33. Building 291, floor plan as a probable Maintenance Dock for Small Aircraft, ca. 1961.

to 126' x 172'; access to this addition is gained by a single door from the bay. Six large, exposed quadrangle trusses span approximately 110' north-south, creating five bays (100' total) of uninterrupted floor space. The quadrangle shape forms the slightly pitched gable roof. The clear height from the floor to the bottom chord of the truss system is approximately 29'. The most prominent features of the building are nine large sliding steel doors at the east elevation and the extensive use of wooden wall and ceiling sheathing. The existing original doors each show nine lights (panes) for a total of 99 lights per door: three panels at the top of each door show nine lights each and three panels at the middle and lower show twelve lights each. Pilot doors are cut into the two end and middle doors. No original drawings were located and neither the architect nor builder is known (Facility Assessment Form/291).

Building 291 still has its original open bay scope and slightly pitched gable roof, but does not retain historic integrity due to extensive architectural modifications. The original rectangular footprint has been obscured by later additions. With the exception of the east elevation, which remains essentially as it was originally constructed, original door and windows openings have been altered or obscured. Original fenestration consisted of three rows of adjacent 6'6" high by 4'6" wide windows extending the entire length of the facade. Approximately 166 of these double-hung, wood sash, sixteen-light windows have been removed at the south, north, and west elevations. Metal doors replace the original wooden personnel doors. Installation of an exterior insulation and finish system replaced the original asbestos shingles. Renovations in 1992 and 1996 resulted in partitioning and other design changes to the interior offices which obscure original finishes (Facility Assessment Form/291).

The building was originally located adjacent to the main runway amid aircraft maintenance shops and hangars (see Figure 10). Many of these buildings still exist, interspersed among more modern facilities. Some original structural and architectural elements remain intact, including extensive wood sheathing and decking, exposed steel trusses, open bays, and nine large aircraft slider doors. These elements allow Building 291 to retain integrity of feeling and association with its construction and use as a WW II hangar. It has functioned continuously in support of aircraft maintenance since it was constructed (Facility Assessment Form/291).

Building 300

Building 300, located in the central Main Base just southeast of the runway, is a permanent facility completed ca. 1943 as a Field Maintenance Hangar (see Figure 10 and Appendix C). The building is irregularly-shaped with a gable roof (Figure 34). Later additions resulted in the modification of its original rectangular footprint. The building was constructed of diagonal sheathing clad with corrugated metal siding. The foundation consisted of concrete wall and column footings and a slab on grade. The floor was

Figure 34. Building 300 as a Jet Engine Inspection and Maintenance Shop in 1996, northwest and southwest elevations

Figure 34. Building 300 as a Jet Engine Inspection and Maintenance Shop in 1996, northwest and southwest elevations.

concrete and the roof consisted of steel trusses supporting purlins and decking clad with corrugated metal. Notable interior features were the large open space and exposed steel columns and trusses. The building is listed as being 123' x 162' with offsets of 10' x 12' and 11' x 15'9" and wings of 50' x 82' (Afterburner Repair, ca. 1965) and 30' x 41'4" (Build-up and Balance rooms, ca. 1986). The original floor space was 20,277 SF, with additions of 270 SF (through 1957), 384 SF (1962), 3,479 SF (1965), 1,260 SF (1986), and a loss of 264 SF (1963), increasing the total to 26,029 SF. Listed functions for the building include Aircraft Engine Inspection and Repair Shop (ca. 1963) and A/M (Aircraft Maintenance?) Engine Inspection and Repair Shop (n.d.). The building is currently a Jet Engine Inspection and Maintenance Shop (Real Property Accountable Record/300; Facility Assessment Form/300).

The earliest drawing for the building (1942) shows the 123' x 162' building composed of a large bay with one small room along the southeast wall (Figure 35). Later additions to the southeast elevation of the

Figure 35. Building 300, floor plan of Field Maintenance Hangar, ca. 1942

Figure 35. Building 300, floor plan of Field Maintenance Hangar, ca. 1942.

Afterburner Repair and Build-up and Balance rooms, as listed above, increased the building dimensions to 162' x 203'. Original elevations showed double-hung windows symmetrically placed the width of each elevation. The northeast and southwest elevations showed large slider doors with identical windows and pilot doors, allowing the entire elevation to open. Two double personnel doors each are on the southeast and northwest elevations. Original drawings note “prefabricated” construction administered by the U.S. (Army Corps) Engineer Office, Albuquerque, New Mexico, dated October 1942. It is possible that steel columns were set in place and steel trusses fabricated at the plant were delivered in one or two pieces and then assembled to the columns. Siding and roof panels were attached at the site after installation of the purlins and girts. Although original drawings were located, the architect and the builder are not known (Facility Assessment Form/300).

Building 300 still has its original open bay scope and gable roof but does not retain historic integrity due to extensive architectural modifications at both the interior and exterior. Several additions have altered the building’s rectangular shape and scale and two offsets have been removed. All original windows (more than 70), wood batten personnel doors, and large slider doors which allowed the entire primary elevation to be open, have been removed. The exterior siding material has changed from corrugated metal to an insulation and finish system and the corrugated metal roof has been replaced. The original concrete floor slab has been painted. Interior partitions have been added for offices. All of these modifications have given Building 300 a drastic change in appearance (Facility Assessment Form/300).

The building was originally located adjacent to the main runway amid aircraft maintenance shops and hangars (see Figure 10). Many of these buildings still exist, interspersed among more modern facilities. Some design elements remain intact and interior floor space and exposed structural elements remain unchanged. These elements, including wall sheathing, steel roof trusses, and steel support columns, allow Building 300 to retain some feeling and association of construction and use as a WW II hangar. It has functioned continuously in support of aircraft maintenance since it was constructed (Facility Assessment Form/300).

Building 301

Building 301, located in the central Main Base just southeast of the runway, is a semipermanent facility completed ca. 1944 as a Field Maintenance Hangar (see Figure 10 and Appendix C). The building is square with an arched roof and an enclosed entryway on the southeast elevation (Figure 36). The building was constructed of wood siding on studs and the roof was clad with wood sheathing and asphalt roll roofing supported by wood trusses. The foundation consisted of isolated concrete footings supporting abutments and a concrete slab. The building is listed as being 202' x 212’’with offsets of 18' x 40' and

Figure 36. Building 301 as a Maintenance Dock for Small Aircraft in 1996, northeast elevation

Figure 36. Building 301 as a Maintenance Dock for Small Aircraft in 1996, northeast elevation.

7'6" x 21'. The original floor space was 46,386 SF, with the loss of 2,684 SF at a later date reducing the total to 43,702 SF. The only listed interim function for the building was Maintenance Dock for Medium Aircraft (ca. 1963), and it has been a Maintenance Dock for Small Aircraft since 1968 (Real Property Accountable record/301; Facility Assessment Form/301).

The earliest drawing for the building (1956) shows a 202' x 215' floor plan with an open hangar maintenance area flanked on the northwest and southeast sides by offices (Figure 37). An offset brick boiler room with a flue is at the southeast elevation and is accessed by double doors. The principal elevation faces northeast and consists of 12 large slider doors, each with two sets of sixteen-light windows. Large slider doors are also at the opposite, southwest elevation. Two sets of double-hung doors and a single-hung door access offices and a larger, central room at this elevation, and a single-hung door accesses the offices at the northwest elevation. The exposed structural system consists of arched roof trusses supported by concrete buttresses. The trusses are assembled using glue-laminated wood top and bottom chords and solid wood web members. This system allows an uninterrupted width (clear span) of 160'.

Figure 37. Building 301, floor plan as a probable Field Maintenance Hangar, ca. 1956.

Figure 37. Building 301, floor plan as a probable Field Maintenance Hangar, ca. 1956.

The arch allows an additional clear height of 21'8" at the hangar center. No original drawings were located and neither the builder nor architect is known (Facility Assessment Form/301).

Building 301 has the original open bay scope, square footprint, and arched roof, and retains integrity in spite of the unsympathetic alterations to the exterior. The northwest and southeast elevations have been extensively modified and the original workmanship lost. Corrugated metal siding obscures the original exterior wood lap siding and fenestration is altered. Approximately 120 original windows have been removed and at least six doors have been added. At least 62 eighteen-light windows have been removed at the northwest elevation facing the runway. At least five door openings have been added and three original doors replaced at this facade as well. Approximately 32 eighteen-light windows, 13 double-hung sixteen-light windows, and 13 fixed sash nine-light windows have been removed from the southeast elevation. Four new single-light slider windows have been added. One six-bay folding door has been removed, one door added, three doors replaced, and one personnel door removed at the southeast facade (Facility Assessment Form/301).

The building was originally located adjacent to the main runway amid aircraft maintenance shops and hangars (see Figure 10). Many of these buildings still exist, interspersed among more modern facilities. Building 301 still conveys its original design characteristics and aesthetic character with many physical attributes intact. The principal (northeast) elevation, southwest elevation, and interior remain essentially as they were originally constructed. The exposed distinctive wood structural system, concrete buttresses, open hangar bay, and large slider doors represent highly distinctive design, materials, and workmanship characteristics. No structural modifications were noted. Arched wood trusses, cross bridging, and beaded tongue-and-groove sheathing at the office walls are distinctive. There is a unique wooden grate for water drainage located at the slider door track/hangar floor junction. Building 301 represents one of the finest examples on HAFB of early wood arched truss hangar construction. Although aircraft technology has changed, the building has always been used in support of aircraft maintenance and continues in the function for which it was originally designed and constructed (Facility Assessment Form/301).

Building 1079

Building 1079, located in the North Area, is a semipermanent facility completed ca. 1943 as a Field Maintenance Hangar (see Figure 10 and Appendix C). It has a rectangular footprint, an arched roof, and offsets on the southeast and northeast elevations (Figure 38). The building was originally constructed of wood lap siding on 1x sheathing attached to wood stud frames. The floor was concrete and the foundation consisted of a concrete wall footing, trapezoidal isolated buttress footings, and a slab on grade. The arched roof was slate on wood sheathing supported by 2" x 8" wood joists on top of the truss chord. The

Figure 38. Building 1079, Maintenance Dock for Small Aircraft in 1997, southwest elevation

Figure 38. Building 1079, Maintenance Dock for Small Aircraft in 1997, southwest elevation (SRA Sharon Baltazar, Dec. 1997).

building is listed as being 117' x 202' with offsets of 18' x 40' (boiler room) and 8' x 9' and wings of 30' x 100' (northern offset) and 20' x 50'. In addition, two balconies are listed at 10' x 20' and 11' x 48'. The original floor space was 24,300 SF, with additions of 4,052 SF through 1957 increasing the total to 28,352 SF. The only listed interim function for the building was HG (meaning unknown) Maintenance (ca. 1968), and it has been a Maintenance Dock for Small Aircraft since 1992 (Facility Assessment Form/1079; Real Property Accountable Record/1079).

Original construction drawings are dated 1942, although they are not stamped as-built. These drawings show a 146'6" x 220'4" building with a large hangar space flanked on the northwest and southeast by offices and tool, coat, and storage rooms (Figure 39). A boiler room extends from the southeast elevation and an unidentified offset is at the northeast elevation. Fourteen large, pocketed slider doors span the

Figure 39. Building 1079, floor plan as a Field Maintenance Hangar, ca. 1942

Figure 39. Building 1079, floor plan as a Field Maintenance Hangar, ca. 1942.

entire southwest (principal) elevation, which faces the runway. There is double door access to the boiler room and single door access to the offset at its southeast (n=1 door) and northeast (n=2) elevations, the hangar on the northeast (n=1), and an office at the southeast (n=1). A brick flue at the northeast corner is not connected to the building. Laminated wood arch trusses span southeast-northwest, providing a clear distance of 160'. Interior partitions extend above the arched roof to provide a clerestory. Notable features include the laminated arched wood trusses, web members of dimensioned lumber, wood crossbracing, the laminated wood top and bottom chords, wood columns, concrete buttressing, large open floor plan, and slider doors. The building exhibits symmetrical fenestration: each office and room have three windows with the exception of the room with the door, which has only two. The boiler room has 10 windows on the northeast and southeast elevations and windows are along the entire northeast elevation including that portion covered by the offset. The Office of the Chief of Engineering (Construction Division), Washington, D.C. provided the plans with Fred N. Severed as the Architect Engineer. The builder is unknown. A sign posted at the principal facade states that the building was established in 1935, although no verification of this could be located and it seems highly unlikely based on the history of AAAF (Facility Assessment Form/1079).

Building 1079 retains the original open bay scope, rectangular footprint, and arched roof, and still has integrity in spite of modifications to the exterior. Original wood lap exterior siding has been replaced with metal and fenestration has been modified. All windows, except at the clerestory, and sliding glass personnel doors have been removed and new openings added. The slate roof has been replaced with roll roofing. The boiler room has been removed (the brick flue is still standing), as have at least one wing and one offset, and there is an addition at the northeast elevation. Fiberglass additions have been altered and there are new finishes for interior walls (Facility Assessment Form/1079).

The building was originally located north of a parking apron facing the runway in the North Area of the base (see Figure 10). Few buildings were in the vicinity of the hangar and none of these contemporary facilities remain. Building 1079 still conveys much of its original design and aesthetic characteristics in spite of extensive alterations to the exterior, which slightly diminish the historic integrity. Structural elements remain intact. The large slider doors, laminated wood trusses, wood columns, and wood crossbracing are intact and foil-backed insulation is still exposed at the ceiling. The concrete floor is still exposed. The interior of the building maintains all aspects of integrity. Building 1079 represents one of the finest examples on HAFB of early wood truss hangar construction. Although aircraft technology has changed, the building has always been used in support of aircraft maintenance and continues in the function for which it was originally designed and constructed (Facility Assessment form/1079).

Storage: Buildings 289, 1236, and 1237

The three storage buildings are classified under the Support Systems subset of the Combat Weapons category. Two of the buildings housed munitions and the third was probably associated with the hangars because of its location and original function (storage of hazardous and flammable materials). Ordnance buildings, such as 1236 and 1237, were needed for ammunition storage. The construction of these buildings with hollow tile walls, as opposed to semisubterranean concrete bunkers (igloos), implies their use for ammunition storage rather than for bombs.

A training base for bomber crews would have maintained large quantities of machine gun ammunition to attain its mission. All later model bombers carried, on average, 10 .50 caliber machine guns. Thompson (1995: 274), a military photographer who accompanied many bombers on combat missions in Africa during WW II, mentions a B-17 carrying 6,860 rounds of .50 caliber ammunition during one combat flight (Figure 40). Although the amount of ammunition carried during training flights was undoubtedly less than for combat, the number of .50 caliber cartridges found during archaeological surveys of HAFB indicates live ammunition was carried and used. Finally, because bombers flew at heights where oxygen was necessary for crew members, all planes carried both installed and “walk-around” oxygen bottles. Thompson (1995:273-274) mentions 13 walk-around bottles on a B-17 that could be recharged through a valve tied into the main plane system. Other items such as fire extinguishers were on the planes and at each parking apron. Buildings like 289 were probably used for storage of such volatile items.

Building 289

Building 289 was originally assessed in 1996 for the German Air Force Beddown building demolition project (Ernst et al. 1996). The form was updated for the current project. The building is located in the central part of the Main Base near the flight line (see Figure 10 and Appendix C). It is a semipermanent facility completed ca. 1943 as a base warehouse for hazardous and flammable materials. The building has a rectangular footprint, is one story, and has a gable roof (Figure 41). This building is not shown on the 1943 Post Map, although another building of the approximate size and in the correct location is noted. It seems likely that Building 289 was designated Building 286 during WW II.

The building was originally constructed of hollow structural clay tile walls atop a concrete slab foundation. A concrete stem wall apparently supported the clay tile. The floor was concrete and the roof was slate on 1x wood sheathing supported by 2" x 4" wood rafters. The building is listed as 15' x 16' with interior space of 240 SF. Listed functions include Base Oil and Grease Storage (ca. 1958) and Aircraft Ground Equipment Storage (n.d.). It is currently used for Aircraft Support Equipment (liquid and gaseous oxygen

Figure 40. "Ordnance Department 50 Cal. Machine Gun Belts"

Figure 40. "Ordnance Department 50 Cal. Machine Gun Belts" (Alamogordo Army Air Base [1942]).

Figure 41. Building 289 as an Aircraft Support Equipment Storage facility in 1996, northwest elevation.

Figure 41. Building 289 as an Aircraft Support Equipment Storage facility in 1996, northwest elevation.

and nitrogen) Storage (Real Property Accountable Record/289; Facility Assessment Form/289). The building is slated for demolition in 1998.

No drawings were located for this building, so one was completed during its assessment for the demolition project (Ernst et al. 1996). Building 289 is small and rectangular (15' x 17') (Figure 42). Access is gained through a single-hung door at the principal (northwest) elevation, and one window is centered in each of the northeast and southwest elevations. The concrete slab floor slopes slightly to the center from all four walls. Wood louvered vents at the northwest elevation and the gable ends appear original. As no drawings were located, neither the architect nor builder is known (Facility Assessment Form/289).

Building 289 retains its single story scope, rectangular footprint, and gable roof. It has served as a storage facility for volatile materials since its construction. Elements of materials and workmanship have been lost, but the building still retains historic integrity in terms of location, design, setting, feeling, and association. Without original drawings the window and door design, including trim, is unknown. It appears, though, that the original windows have been replaced with Plexiglass® and new wood trim has been added. A removable, painted wood muntin grid has been added, giving a multiple-light effect. Unfinished gypsum board panels have been attached to a new plywood ceiling at the interior. The original door has been replaced with one of metal. Metal fascia wrap obscures the original wood fascia. The roof is now asphalt shingles, perhaps on the original wood frame, and the structural clay wall tiles have been painted (Facility Assessment Form/289).

Building 289 retains historic integrity. Although it has been altered aesthetically by the replacement of original architectural elements, no structural modifications were noted. If Building 289 was Building 286 during the war, it was probably associated with aircraft maintenance hangars such as Building 291 to the west (see Figure 10). Other contemporary buildings in the locale have been demolished and a relatively open area to the southwest has been filled with new construction (Facility Assessment Form/289).

Building 1236

Building 1236 was originally assessed in 1996 for a roof replacement project (Tagg 1996). The form was updated for the current project. The building is located in the Munitions Storage Area north of the Main Base (see Figure 10 and Appendix C). The semipermanent facility was completed ca. 1943 for Spare Inert (Munitions) Storage. The real property records and 1943 Post Map indicate that this facility was Building 1206 during WW II (CE File IE 288; Real Property Accountable Record/1236).

Figure 42. Building 289, floor plan as an Aircraft Support Equipment Storage facility in 1996

Figure 42. Building 289, floor plan as an Aircraft Support Equipment Storage facility in 1996.

Building 1236 has a rectangular footprint and is single story with a gable roof (Figure 43). The building was constructed using hollow structural clay tile walls atop a concrete foundation. Concrete bond beams support wood trusses and 1" x 12" wood sheathing. The floor is concrete and the roof slate. The building is listed as being 35' x 82' in size with an 8' x 14' offset (mechanical room) and 2,757 SF of interior space. Listed functions include Igloo Storage (n.d.) and Above Ground Magazine Storage for A, B, and C materials (ca. 1971). The building has been used for Spare Inert (Munitions) Storage since 1987 (Facility Assessment Form/1236; Real Property Accountable Record/1236).

Figure 43. Building 1236 as a Spare Inert (Munitions) Storage facility in 1996, southwest and southeast elevations.

Figure 43. Building 1236 as a Spare Inert (Munitions) Storage facility in 1996, southwest and southeast elevations.

Original 1942 drawings were located for the building but are not stamped as-built. These drawings show a rectangular, 34' x 81' building with two sets of double swinging doors at each gable end and nine single-hung personnel doors symmetrically spaced along the northwest and southeast elevations (Figure 44). The 8' x 14' mechanical room with a double-hung access door is at the rear (northwest) elevation. The facility was heated using "tube wall radiators" and steam heat, which apparently necessitated three large vent units at the roof ridge and vents in each gable end. Although original drawings were located, neither the architect nor builder is known (Facility Assessment Form/1236).

Figure 44. Building 1236, floor plan as a Spare Inert (Munitions) Storage facility, ca. 1942

Figure 44. Building 1236, floor plan as a Spare Inert (Munitions) Storage facility, ca. 1942.

Building 1236 retains its single story scope, rectangular footprint, and gable roof. It has served as a storage facility for explosive materials since its construction in 1943. Modifications to this building appear to be architectural rather than structural. At least eight exterior personnel door openings in the structural clay tile walls have been filled with CMUs and only one single-hung door remains at the southeast elevation. Wire mesh has been added to the interior to catch fallen roof tiles and all interior partitioning has been removed. Discrepancies exist between documentary sources for the building, making assessment of modifications difficult. Real property records indicate the roof was originally slate, but this was not verified by original drawings. At the time of the assessment, asbestos cement tile covered the roof. As-built drawings for a 1976 project (CE File 1497) illustrate the addition of asbestos cement roof tile for other buildings in the Munitions Storage Area, suggesting that the tile on Building 1236 may have been added at this time also. Original drawings also show two sets of swinging doors at the gable ends although single, large slider doors are present currently. The asbestos shingles have been replaced with asphalt composition shingles on both the roof and gable ends since the time of the assessment (Facility Assessment Form/1236; Tagg 1996).

Building 1236 maintains historic integrity. It is still situated in the fenced Munitions Storage Area although, with the exception of Building 1237, all contemporary buildings have been demolished (see Figure 10). Interior design and construction elements remain intact. The structural clay tile walls, rough-sawed wood truss system, and 1" x 12" sheathing represent distinctive WW II design features and workmanship on HAFB. Although most original doors and windows have been blocked in, the remaining openings, framing, and wall system are intact. The interior also remains as it was originally designed, including exposed wood trusses, brickwork, and sheathing. Building 1236 continues to serve in the same capacity for which it was designed and is a unique representation of regional WW II combat support structures (Facility Assessment Form/1236).

Building 1237

Building 1237 was originally assessed in 1996 for a roof replacement project (Tagg 1996). The form was updated for the current project. The building is located in the Munitions Storage Area north of the Main Base (see Figure 10 and Appendix C). The building was completed ca. 1943 as a permanent facility for Base GAR (meaning unknown) Storage. The Real property records and 1943 Post Map indicate that this facility was Building 1208 during WW II (CE File IE 288; Real Property Accountable Record/1237).

Building 1237 has a rectangular footprint and is single story with a gable roof (Figure 45). The building was constructed using hollow structural clay tile walls atop a concrete foundation. Concrete bond beams support wood trusses and 1" x 12" wood sheathing. The floor is concrete and the roof slate. The building

Figure 45. Building 1237 as an Above Ground Magazine Storage facility for A, B, and C materials in 1996, southwest and southeast elevations.

Figure 45. Building 1237 as an Above Ground Magazine Storage facility for A, B, and C materials in 1996, southwest and southeast elevations.

is listed as 35' x 95' with an 8' x 14' offset (mechanical room) and 3,285 SF of interior space. There are no listed interim functions for the building. It appears to have been used for an Above Ground Magazine Storage for A, B, and C materials since 1971 (Facility Assessment Form/1237 Real Property Accountable Record/1237).

Original 1942 drawings were located for the building but are not stamped as-built. These drawings show the rectangular, 34' x 97' building as a larger version of Building 1236. The double swinging doors, single personnel doors, mechanical room, roof vent units and vents are situated at the same elevations with only two differences: Building 1237 had 11 doors and four large roof vents (Figure 46). Although original drawings were located, neither the architect nor builder is known.

Building 1237 retains its single story scope, rectangular footprint, and gable roof. It has served as a storage facility for explosive materials since its construction in 1943. Modifications to this building are also identical to those of Building 1236 and appear to be architectural rather than structural. Only one personnel door remains functioning and wire mesh was added to the interior. Record discrepancies suggest asbestos roof shingles and large, single slider doors at the gable ends may have been added at a later time. Asphalt composition shingles were added after the building was assessed (Facility Assessment Form/1237; Tagg 1996).

Figure 46. Building 1237, floor plan as a Base GAR (Garrison) Storage facility, ca. 1942

Figure 46. Building 1237, floor plan as a Base GAR (Garrison) Storage facility, ca. 1942.

Building 1237 maintains historic integrity. It is still situated in the fenced Munitions Storage Area although, with the exception of Building 1236, all contemporary buildings have been demolished (see Figure 10). Interior design and construction elements remain intact. The structural clay tile walls, rough-sawed wood truss system, and 1" x 12" sheathing represent distinctive WW II design features and workmanship for HAFB. Although most original doors have been blocked in, the remaining openings, framing, and wall system are intact. The interior also remains as it was originally designed, including exposed wood trusses, brickwork, and sheathing. Building 1237 continues to serve in the same capacity for which it was designed and is a unique representative of regional WW II combat support structures (Facility Assessment Form/1237).

PROPERTY TYPE III: TRAINING FACILITIES

The four Training Facilities were constructed during WW II and include two Base Support buildings (Buildings 40 and 107) and two Combat Training facilities (Building 599 and the Jeep Target). The buildings are listed in HAFB Real Property Accountable records as being constructed in 1943 in the Main Base and are shown on the 1943 Post Map. Buildings 40 and 107 were administrative classrooms, and Building 599 was an indoor small arms (1,000 inch) firing range. The three buildings are in use for functions other than that for which they were constructed and Buildings 107 and 599 have either been, or are in the process of being, demolished. No real property records have been located for the Jeep Target, but it is present on the 1943 Post Map northwest of the North Area. It currently retains its original use as a training facility. The buildings and structure were just a few of the training facilities used to prepare aircrews for overseas combat assignments. For WW II buildings, Whelan et al. (1997:15) use the broad category of Education to include these types of properties, those “associated with the training and education of military personnel . . .include[ing] classrooms and specialized training facilities.” For the purpose of this report, they have been divided into Base Support for classrooms and Combat Training for specialized training facilities.

Base Support (Education): Buildings 40 and 107

These two buildings are included in the Base Support category because they were used as classrooms. It is unknown, however, what type of training occurred there. Because the buildings are located within areas of the base with dormitories and administrative buildings and were constructed in WW II, it has been assumed that they were military training classrooms and not schools for military dependents.

AAAF was an OTU base where crews trained together in the use of the bomber they would take overseas; when they finished this combat training, they were sent to war. A B-24 combat crew normally consisted of 10 men, including four officers and six enlisted men. The four officers were the pilot, copilot, bombardier, and navigator. The enlisted men included the flight engineer, radio operator, and four gunners (Sheehan 1986:164-165). Before these men were assigned together as a crew, they would have completed basic training at other bases in their career fields: preflight and pilot training, bombardier school, flight engineering school, and gunnery school (Childers 1990:17-19).

Once a bomber crew was assembled at a base such as AAAF, they went together through countless classes and training exercises that focused on teaching each of the 10 men his exact job as it related to a bomber and how to perform as a crew (Figure 47). The crews were issued armloads of technical manuals, instructional books such as *Your Body in Flight* and *Army Air Forces Radio Facility Charts*, and other materials for the classes and training exercises. The first two weeks consisted of relentless ground classes, familiarizing them with flight procedures, aircraft identification, aircraft maintenance, first aid, and the operational doctrine of high altitude strategic bombing. They studied aircraft engines and airframes, weather, communication in code, and aerial navigation, and they were drilled and inspected between 14 and 16 hours a day, six to seven days a week (Childers 1990:24-25; Sheehan 1986:157, 165).

Figure 47. "Gunnery Schools." Aircrew members in a classroom setting at AAAF, ca. 1942

Figure 47. "Gunnery Schools." Aircrew members in a classroom setting at AAAF, ca. 1942 (Alamogordo Army Air Base [1942]).

In addition, each man attended specialized classes in his career field: pilots in a Link trainer, a mechanical cockpit that simulated actual flight conditions; the A-2 bomb trainer for bombardiers and pilots; communications reviews for radio operators; and aerial gunnery practice for gunners (Figure 48). For example, the Radio Operator-Mechanic went to radio school, which included demanding courses in electronics, mechanics, and code, as well as a comprehensive study of the radio. Sitting in labs at all hours, individuals mastered the internal electronics of the radio, built generators, studied vacuum tubes, amplifiers, transformers, and transmitters, and learned Morse code. They learned the theory behind and maintenance for each part, how it worked and could be repaired, and how to improvise in the air if a radio was damaged or malfunctioned (Childers 1990:11, 20-25; Sheehan 1986:165-166).

Figure 48. "Gunnery Schools." Aircrew members in a classroom with bomber turrets, ca. 1942

Figure 48. "Gunnery Schools." Aircrew members in a classroom with bomber turrets, ca. 1942 (Alamogordo Army Air Base [1942]).

Only then were the crews allowed to begin flying the bombers. They were on the flight line constantly, flying every day in all types of weather. Once started, they flew at least four hours a day, seven days a week, in addition to their continual classes. They flew formations with other planes, practiced tight combat formations, flew on instruments, practiced high and low altitude bombing and air-to-ground gunnery, and flew long cross-country missions, completing complicated navigational problems and simulated bomb runs. Pilots learned to keep the plane steady for bombing runs on ranges such as ABGR and radio operators practiced their trade at the same time, always accompanying the plane when it was in the air. Bombardiers practiced dropping 100 pound, sand-filled blue practice bombs on ground targets, while gunners practiced aerial gunnery on both air-towed and ground targets. Long cross-country flights were taken to teach navigators how to keep on course. Engineers kept the plane in the air through extensive knowledge of the fuel and electrical systems, the engines, the hydraulics, and general troubleshooting techniques (Childers 1990:20-26; Sheehan 1986:165-166).

Building 40

Building 40 is located in the central part of the Main Base just off the primary base road (see Figure 10 and Appendix C). The building was completed ca. 1943 as an Academic Classroom School building, although it is listed as an Exchange Sales Store on the Real Property Accountable form. It is a one story semipermanent facility with an I-shaped footprint and an entrance lobby creating the offset (Figure 49). Individual gable roofs cover the main building and two wings. The building was constructed of asbestos shingles on wood sheathing and studs (the real property form indicates drop siding was used, but this is crossed out and asphalt siding added). The foundation is a continuous concrete footing and foundation wall around the perimeter with isolated piers. There is a wooden floor and 55 pound roll roofing on wood sheathing supported by wood rafters. The building is listed as being 50' x 75' with a 20' x 30' offset, two 25' x 108' wings (classrooms), and three vests—one 5' x 8' and two 5'4" x 6'6". It had 9,790 SF of interior space, although at some point this was increased to 9,860 SF. Listed functions for the building include Exchange Sales Store (n.d.), Field Training Facility (n.d.), Headquarters

Group (ca. 1976), and Family Services Center (ca. 1988). It is currently the Family Support Center (Facility Assessment Form/40; Real Property Accountable Form/40).

The original 1943 drawings indicate the interior consisted of a lecture hall and alternate classrooms in the center (main building), with classrooms in each wing (Figure 50). The building is shown as 108'2" x 125'8", with the main building 75' long, and the wings 25'4" x 108'2" each. Two sets of double-hung doors with concrete stair landings on the southwest and northeast elevations of the main building access hallways adjacent to the wings. A double-hung door is also situated in one wing. Fenestration is symmetrical with 12 sets of double windows situated at the northeast and southwest elevations of the main building and 20 sets of double and five sets of triple windows at the northwest and southeast elevations of the wings. Although the original drawings cite the Washington, D.C. War Department (Engineering Section) in the title block, neither the architect nor builder is known (Facility Assessment Form/40).

Building 40 still shows its single story scope, I-shaped footprint, and gable roofs. The building does not, however, retain historic integrity due to extensive renovations occurring at both the interior and exterior. No major structural modifications were noted, though, and the original wood frame structure seems intact. All original windows have been removed and three new ones installed at the northwest elevation. New

Figure 49. "Holloman Base Exchange, Building 40, on First Street," ca. 1956, southwest or northeast elevation

Figure 49. "Holloman Base Exchange, Building 40, on First Street," ca. 1956, southwest or northeast elevation (HADC 1956, HAFB Environmental Flight, Cultural Resources Photo Archives, Emily K. Lovell collection).

doors replace original wood doors, with the possible exception of the double metal and glass doors at the southwest elevation, and a double door replaces a single door at the northeast entrance. An architectural design feature partially obscures the original facade at the northeast entrance. The original siding is obscured by the recent addition of an exterior insulation and textured stucco finish system. The roof is now of asphalt shingles. Extensive interior remodeling has resulted in the addition of numerous partitions. Carpeting, vinyl flooring and base, painted gypsum boards, and acoustical drop ceilings obscure the original finishes (Facility Assessment Form/40).

The building is located along the primary Main Base road in an area that once had a group of buildings that were probably administrative or warehouses (see Figure 10). None of these contemporary buildings remain today. Building 40 has been continually used for a variety of functions since its construction in 1943. The renovations have obscured or destroyed all of the original design elements and almost no original workmanship remains visible. No feeling or association with the original use of this building as an academic classroom has been retained (Facility Assessment Form/40).

Building 107

Building 107 was originally assessed for the German Air Force Beddown building demolition project (Ernst et al. 1996). The form was updated for the current project. Building 107, located in the east-central

Figure 50. Building 40, floor plan as an Academic Classroom School facility, ca. 1943

Figure 50. Building 40, floor plan as an Academic Classroom School facility, ca. 1943.

part of the Main Base, was completed ca. 1943 as an Academic Classroom (see Figure 10 and Appendix C). It is a one story temporary facility with a gable roof and exhibits a rectangular footprint with offsets on the northwest, southwest (n=2), and southeast elevations (Figure 51). The building was constructed of a wood frame with cement asbestos shingle siding. The foundation includes concrete wall footings and a concrete slab. The floor is concrete and the roof slate (although slate is crossed out on the real property form and asphalt roll roofing is written in). The building is listed as being 50' x 192' with two 5' squareoffsets (southwest entryways?) and an 11' x 24' wing (northwest entryway?). It had 9,650 SF of interior space, with additions of 264 SF through 1957 increasing the total to 9,914 SF. Listed functions for the building include Administrative Office (ca. 1962), Security Police Operations (ca. 1974), Social Action Facility (ca. 1988), and Weapons System/M (Maintenance?) Management Facility (ca. 1995). It was used by the German Air Force until recently when it was abandoned for being substandard (Real Property Accountable Record/107; Facility Assessment Form/107). It is slated for demolition in 1998.

Figure 51. Building 107 as a Substance Abuse/German Air Force Administrative Office in 1996, southeast and northeast elevations

Figure 51. Building 107 as a Substance Abuse/German Air Force Administrative Office in 1996, southeast and northeast elevations.

The earliest drawing (1969) shows a 50'9" x 191'4" building with covered entryways on the southwest (n=2) and southeast elevations (Figure 52). An offset at the northwest elevation is 12'3" x 24'4" and has a double-hung door on one side and a single-hung door on the other. It has no interior access to the building and may represent a mechanical room. The southeast entryway is divided by a wall and has two single-hung doors. The two southwest entryways have single-hung doors, and there are three additional single-

Figure 52. Building 107, floor plan as an Administrative Office, ca. 1969

Figure 52. Building 107, floor plan as an Administrative Office, ca. 1969.

hung doors and 14 single windows at each of the southwest and northeast elevations. The floor plan shows a central corridor with rooms on each side and a series of small rooms at the northwest end. No original blueprints were located and neither the architect nor builder is known (Facility Assessment Form/107).

Building 107 is still a one story rectangular facility with a gable roof. However, the building no longer retains historic integrity due to extensive alterations occurring at both the interior and exterior. Records indicate substantial modifications in 1969 and additional alterations in 1986 and 1989. The exterior has a stucco finish over the original wood frame. Eaves and gable ends have small overhangs trimmed in wood. The roof is now clad with asphalt rolled roofing. The interior room layout, finishes, and door/window schedules have been extensively altered with each renovation. An open porch supporting a plywood, shed roof extends along most of the principal (southwest) facade, altering the original appearance. Aluminum windows replace original wood sashes and aluminum and flush metal doors replace originals. Original roof and siding materials have been removed. Additions at the northwest, southwest, and southeast elevations partially obscure original elevations (Facility Assessment Form/107).

The building was located in the east-central Main Base adjacent to the Motor Pool and within a series of eight identical buildings (see Figure 10). None of these contemporary buildings remain today. A railroad spur constructed in 1955 fronts the building, but is no longer in use. Building 107 has been continuously used for a variety of functions since its construction in 1943. Nearly all original elements have been removed or obscured and the building retains original scale and profile only. No feeling or association with this building's original use as an academic classroom remains (Facility Assessment Form/107).

Combat Training (Education): Building 599 and the Jeep Target

One building and one structure are listed under Combat Training because they were associated with weapons use. Building 599 was used for small arms training, while the

Jeep Target was used for training bomber turret gunners. Many bomber crew members carried handguns in the event they had to bail out over enemy territory. Both Childers (1990:32) and Sheehan (1986:174) mention B-24 aircrews being issued, and required to wear, .45 caliber Colt automatic pistols. In addition, Security Police and most base military personnel received periodic training in the use of small arms. Aerial gunners were used in large numbers on all bombers during WW II. B-17s and B-24s usually carried 10, and B-29s from 10 to 14, aircrew (see Table 7). With the exception of the pilot and copilot, who may have received some gunnery practice, the remaining crew members were intensively trained as gunners in the use of turrets and tracking moving targets. As mentioned above, the aircrew included four full time gunners in the tail, belly, and waist positions, as well as the navigator, flight engineer, and bombardier who acted as gunners before and after they achieved their primary tasks. B-17s had two manned, movable gun turrets, one for the navigator located on the top of the fuselage just behind the cockpit and the ball turret behind the wings on the belly. Later B-17Gs also had a remote control "chin" turret under the nose cone (Donald 1965; Jablonski 1965). The B-24s had a similar design with turrets on the top and bottom of the plane and in the tail. On later models, nose turrets were present (Birdsall 1973; Taylor 1991).

Childers (1990:13) describes a typical flexible gunnery training class for aircrew at Tyndall Field Aerial Gunnery School in Panama City, Florida:

> After the first week of orientation and classroom instruction flexible gunnery class 44-2 moved out through a desolate landscape of sandy hillocks and scrub pines to one of the many firing ranges. They began shooting skeet, then progressed to firing from moving platforms, from small arms to automatic weapons and finally to the heavy machine guns. They learned how to operate the power-driven turrets, how to sight and swing them and their twin fifties. Wedged into the tiny, cramped turret, they fired from the nose, the belly, and the tail, swiveling the Plexiglas and metal mechanism towards the moving targets downrange. They fired from fixed positions, and then from mounts on moving platforms on the ground, and finally prepared for air-to-air gunnery.

Sheehan (1986:166) also quotes a pilot at Biggs Field in El Paso, Texas, who wrote in a letter to his brother: "Lots of .45 cal. pistol, .50 cal. machine gun & skeet shooting with 12-gauge pump guns too . . . "

The Jeep Target, consisting of a number of features identified as an archaeological site (HAR-082/LA 104440), was the firing range for AAAF. It contained a skeet range and shooting-in butts, as well as the Jeep Target. The Jeep Target is thought to represent a "Gunnery Facility, Moving Target Range." Knight and Leavitt Associates, Inc., (1992) documented similar features near Nellis AFB, Nevada, and located construction drawings. The features were identified as part of the Moving Target Range facility constructed during 1942 and 1943 at the Las Vegas Army Gunnery School. Eight large and one smaller triangular-shaped berms were identified. They were constructed by R.D. Merrill Company of Helena, Montana. The large ranges have 150' radius curves with a long side of 1,500' and two shorter sides of 960.47'. The berms are 4' high. They were used for .50 caliber machine gun target practice. The smaller range, less than half the size of the larger style, was used for .22 caliber training.

The operation of the ranges involved a moving target and trainees using turret-mounted machine guns. Sperry turrets, at firing points 300 ft from the south side of each range, carried four twin-mounted .50 caliber Browning M2 machine guns. Trainees swiveled the turrets and shot at targets moving around a track inside the berm. Targets were moved along a railway within each berm by target cars powered by governor-regulated Ford V-8 engines. They operated in a counterclockwise direction. An operator set the throttle and transmission and the target was moved by the car. The car was controlled by levers from a concrete base 500' from the south side of the berm. To stop the target car, levers tripped a device that cut the ignition and set the brake (Knight and Leavitt Associates, Inc., 1992). Bob Leavitt of Knight and Leavitt (personal communication 1997) said the targets mounted on the cars extended above the berm, which protected the vehicle from bullets. Leavitt also indicated that from the description of the HAFB range, it was probably a flexible gunnery target array. A limited understanding of the operation of the range can be viewed in the film *Rear Gunner* produced for the Army by Warner Brothers and starring Burgess Meredith as a gunner and Ronald Reagan as an Army pilot.

Building 599

Building 599, located in the southwest corner of the Main Base, was completed ca. 1943 as a 1,000 inch Small Arms Range (see Figure 10 and Appendix C). It is a one story temporary facility with a gable roof and exhibits a rectangular footprint (Figure 53). The building was originally constructed of asbestos cement shingles on tongue-and-groove sheathing and a wood frame. The foundation included concrete piers, the floor was wood and concrete, and the roof was asphalt shingles on a wood frame. The building is listed as being 40' x 108' with 5,599 SF of interior space. Changes in size included the loss of 199 SF (through 1957) and 1,080 SF (1973), for a final total of 4,320 SF. Listed functions for the building include Rod and Gun Club (ca. 1958), Small Arms I/D (Indoor?) Range (ca. 1960), Small Arms Indoor Range (n.d.), Small Arms Training (ca. 1973, n.d.), SAMTU (Small Arms Maintenance Training Unit?) Training (ca. 1980), and Combat Arms Training Maintenance (n.d.). It was used as storage for the Base Exchange until recently when it was abandoned as being substandard for continued use. It was demolished in January 1997 (Facility Assessment Form/599; Real Property Accountable Record/599).

The earliest available drawing, dated 1986, shows the 40'6" x 108'8" building with no interior partitioning (Figure 54). A small mechanical room is adjacent to the northeast elevation. Fenestration is symmetrical. There are five single-hung doors and nine windows at the northeast elevation. Two doors are at the northwest elevation and one each at the other elevations. Four windows flank a door on the northwest elevation and five windows are side by side, opposite the doorway, on the southeast elevation. No original blueprints were located and neither the architect nor builder is known (Facility Assessment Form/599).

Prior to demolition, Building 599 was still a one story rectangular facility with a gable roof, although it did not retain historic integrity due to major architectural changes at both the exterior and interior. The original structural system had not changed, but fenestration was extensively altered. Only the interior five panel wood doors appeared original. All original exterior doors, windows, and trim were replaced with different materials and type or removed and the openings framed in. CMUs were added between original piers at the foundation. A new exterior insulation and finish system was added at the exterior of all

Figure 53. Building 599 as a Base Exchange storage facility in 1995, southeast and southwest elevations

Figure 53. Building 599 as a Base Exchange storage facility in 1995, southeast and southwest elevations.

elevations, obscuring the original tongue-and-groove wood siding. The interior floor plan appeared to have been modified for different functions, including one classroom at the north elevation (Facility Assessment Form/599).

The building was located in the southwest portion of the Main Base within a large area of rectangular buildings (see Figure 10). None of these contemporary buildings remain today. Building 599 was continuously used for a variety of functions after its construction in 1943, although most functions were related to its original use as an indoor small arms range. Nearly all original elements had been removed or obscured and the building retained no feeling or association with its original use prior to its demolition (Facility Assessment Form/599). The demolition of the building has removed it from further management considerations.

Figure 54. Building 599, floor plan as a Small Arms Training facility(?), ca. 1979

Figure 54. Building 599, floor plan as a Small Arms Training facility(?), ca. 1979.

Jeep Target

The Jeep Target, located northwest of the West Area, was originally constructed ca. 1943 as a training facility for turret gunners (see Figure 10 and Appendix C). Its location is indicated on the 1943 Post Map by a directional arrow and label pointing to the northwest of the Cantonment Area. The structure was originally recorded during an archaeological survey as a feature within a larger site (HAR-082/LA 104440) (Michalik 1994) (Figure 55). The Jeep Target does not have a real property number and no drawings or documentation were located for the structure. The feature can be seen on a 1945 aerial photograph although, due to the scale, little can be identified other than the shape and two openings in the berm. Neither the builder nor architect is known. A scale drawing of the feature was completed by the author for this project. It is currently called "The Pit" and is used as a training area for Civil Engineer Prime Beef exercises and Disaster Preparation and Combat Skills.

The Jeep Target is a large, roughly triangular-shaped earthen berm with an associated concrete track (Figures 56 and 57). It is approximately 600' x 1,500' with about 900,000 SF of open area within the berm. The berm is earthen, averages 8' in height, and tapers in width from 2' to 6' at the top to 30' to 35' at the base. The triangular feature has two 25' wide breaches at the rounded apexes and consists of four relatively straight segments (northern, southeastern, southern, and southwestern). The longest, the northern segment, is approximately 1,700' long from the breaches in the southwestern and northeastern corners. The three southern segments are distinguished by 30 degree curves in the berm. From the northeast breach, the southeastern segment is approximately 785' long. The southern, center, segment is approximately 370' long, and the southwestern segment is 765' long to the southwestern breach.

In association with the berm are hundreds of thousands of .50 caliber bullets. These bullets, both intact and flattened by impact, are embedded in or lying on the following parts of the berm slopes: 600' along the interior of the north segment from the southwest corner; approximately 330' along the exterior of the southeast segment from its intersection with the south segment; the entire exterior of the south segment; and approximately 485' of the exterior of the southwest segment from its intersection with the south segment. The heaviest densities are in a 600' long area with the south segment at the center and the northeastern 300' of the north segment scatter.

The track consists of two continuous concrete footings that circle the entire diameter of the berm. The footings are 1'52" wide, 6" thick, and are 2'8" apart (see Figure 57). The concrete has been poured in 15' long sections. Each section has three bolts, evenly spaced along the interior edge, within 3" square insets. It appears the bolts were set into wood within the insets and had concrete poured over them. Most of the

Figure 55. Site map of HAR-082/LA 104440 with the Jeep Target (Feature 4) and associated features

Figure 55. Site map of HAR-082/LA 104440 with the Jeep Target (Feature 4) and associated features (adapted from Michalik 1994).

Figure 56. The Jeep Target, a possible flexible gunnery target array facility, ca. 1945

Figure 56. The Jeep Target, a possible flexible gunnery target array facility, ca. 1995 (on file at HAFB Environmental Flight).

Figure 57. The Jeep Target, plan view as a possible flexible gunnery target array facility ca. 1945, with jeep track and earthen berm details

Figure 57. The Jeep Target, plan view as a possible flexible gunnery target array facility ca. 1945, with jeep track and earthen berm details
(adapted from a 1945 aerial photograph of AAAF and 1997 field inspection).

wood has rotted. The track is situated on the interior side of the southern berm segments. It is on an earthen bench that is about 3' higher than the open area within the berms, and is 5'6" from the base of the berm. The track is level except where it turns at the northeast and southwest corners. Through the turns, the track is slanted away from the southern segments and into the northern segment, with the interior footing at least 1'6" lower than the exterior footing. The track extends through the two breaches and is situated on the exterior of the northern segment. It is level, like the interior track, and about 6'6" from the berm base.

The Jeep Target is still a rectangular berm with a concrete track, and it appears to retain historic integrity, although it has been disturbed and modified after its original construction. Although no drawings or documentation were located, it appears that the feature maintains almost all aspects of its original design elements such as the earthen berm and concrete jeep track, which are relatively intact. The berm has been breached in the southern segment and now has a gravel road through the 20' gap. Two 8' x 12' x 7' bunkers, constructed of railroad ties, telephone pole segments, and plywood have been constructed in the berm on each side of the new opening. Similar bunkers are also located at the southwest breach (8' x 8' x 7') and on the exterior of the north segment (5' x 7' x 4'). These bunkers have caused the berm to erode in those areas. The berm also has a few smaller foxholes excavated into the sides and top, and two trenches cut through the top. A tracked vehicle has driven over the berm in two places and there is minimal erosion.

The concrete track has been disturbed in three areas: a 20' section is missing at the new opening, a 15 to 19' section is missing at the intersection of the south and southeast segments, and a 20' section is buckled near the southwest corner of the north segment. The open area within the berms has been heavily impacted and it is doubtful if any original features remain. The east half of the area has a gravel base. On the gravel area are three buried trailers, three plywood tent frames, one tower platform, and six concrete pads. There is also a series of 4" x 4" upright wood posts with plastic numbers on them situated around the interior of the concrete track, and there are many two-track road cuts.

Thousands of recent 5.56 mm and .30 caliber blank cartridges litter the open area and berm.

The Jeep Target is located in a remote part of the base that has been a training area since WW II (see Figure 10). The remains of numerous contemporary features are still present in the area including a skeet range, foxholes, a gun emplacement area where gun turrets could be mounted, a smaller circular track, berms, collapsed structures, and trash dumps. All of these features, if not associated with the Jeep Target, are the result of military training activities. The Jeep Target and surrounding area appears to have functioned for training purposes since its construction ca. 1943. The feature still exhibits characteristics unique to its function as a possible flexible gunnery target array. It is similar to the large moving target ranges identified near Nellis AFB in Nevada, although further research will be necessary to determine if the HAFB feature is unique or unusual.

PROPERTY TYPE IV: MATERIAL DEVELOPMENT FACILITIES

The remaining 15 early Cold War buildings and structures are categorized as Material Development Facilities. They are located in the unimproved Supplemental Area or near-in acreage of HAFB outside and north of the Cantonment Area (see Figure 12). The Material Development Facilities include seven test sites (five buildings and two structures), five Communication/Instrumentation buildings, and three Storage/Support facilities. Real Property Accountable records indicate the facilities were constructed between ca. 1947 and 1962. The USAF provided letter designations based on function for all stations associated with missile and rocket testing on HAFB and WSMR (Table 8).

Table 8
USAF Station Designation (HAFB 1951)

Designation	Type of Station
Able	Currently used for Office Intercom stations
Baker	Launching and Flight Control
Charlie	Launchers and Launching Equipment
Dog	Electronic: Doppler Beacon

Easy	Electronic: Beacon Triangulation (A.F. Cambridge Research Laboratory System)
Fox	Electronic: Beacon Triangulation (MIRAN)
George	Optical: Ballistic Camera
Howe	not presently assigned
Item	Optical: Acceleration Camera
Jig	Electronic: Telemetering
King	Electronic: Chain Radar
Love	not presently assigned
Mile	Optical: Servo-tracked Camera
Nan	Optical: Fixed Motion Picture Camera
Oboe	Skyscreen
Peter	Optical: Cinetheodolite
Queen	Communication Center
Roger	not used
Sugar	Electronic: S-Band Radar
Tare	Optical: Tracking Telescope
Uncle	Optical: Manually Tracked Camera
Victor	not presently assigned
William	not presently assigned
X-Ray	Electronic: X-Band Radar
Yoke	designation no longer used
Zebra	designation no longer used

Test Sites: Buildings 1116, 1139, 1142, 1440, 1442, and JB-2 Ramp and Test Stand

The seven test sites are located within two missile launch complexes previously documented as archaeological sites (see Table 3). The Missile Test Stands Area (HAR-041/LA 104274) contains Buildings 1116, 1139, 1142, and the JB-2 Ramp and Test Stand structures. Buildings 1440 and 1442 are within the Able 51 site (HAR-075/LA 107799). Four of the buildings (1116, 1139, 1142, and 1440) are observation blockhouses that served as remote control and launch points and afforded protection to the launch crew in the event of a mishap while a test vehicle was on the launch pad (Mattson and Tagg 1995:25). Building 1442, the JB-2 Ramp, and the Test Stand were the actual launch or test facilities. These seven facilities are currently either vacant or abandoned (n=3) or used for storage (n=4).

A variety of missiles, rockets, drones, and other test vehicles were developed and/or tested at HAFB starting in 1947 and resulting in the construction of test stands and support facilities throughout the base. The three major test facilities include the Missile Test Stands Area (MTSA), the High Speed Test Track (HSTT), and the ZEL site/Able 51 (see Figure 11). The HSTT buildings were previously investigated in 1996 (Fulton and Cooper 1996). The MTSA and ZEL site facilities are discussed here.

Missile Test Stands Area: Buildings 1116, 1139, 1142, JB-2 Ramp, and Test Stand

As discussed previously, three ongoing missile programs were transferred to AAAF from Wendover AAF in 1947 including the Ground-to-Air Pilotless Aircraft (Gapa), JB-2 Loon, and the Tarzon (tall boy range and azimuth only). Three launch complexes were immediately constructed within what is today known as the MTSA for the Gapa, the JB-2, and the newly developed North American Test Instrument Vehicle (Nativ). A fourth complex, for the Aerobee rocket, was added in 1948. During the late 1940s, the MTSA consisted of three concrete observation buildings, three firing aprons with launch towers, an inclined dirt launch ramp, and over 100 associated support facilities. The MTSA was used extensively from 1947 through the late 1950s with a Gapa being the first missile launched in 1947 and the Aerobee rocket program conducted through 1959. The facilities were apparently used briefly for other test vehicle programs, such as the Falcon, into the 1960s. The programs and launch complexes are discussed in depth by Mattson and Tagg (1995) and Weitze (1997) and will only be briefly touched on here.

The first operational missile tested at HAFB was the Gapa. The launch complex was constructed simultaneously with that for the Nativ, and by November 1947, the complex included a blockhouse, a launch pad with two towers, a zero length slant angle launcher, and a vertical-minus-five-degrees tower (Weitze 1997:24). The Gapa, officially designated as MX-606, was an experimental, high velocity test vehicle tested between 1946 and 1950 (Figure 58). Three different series of the missile were involved in

Figure 58. Gapa (MX-606) model no. 601 prepared for launch, after March 1948

Figure 58. Gapa (MX-606) model no. 601 prepared for launch, after March 1948. Nativ blockhouse (Building 1116) and launch tower are in the background (HAFB Environmental Flight, Cultural Resources Photo Archives).

the test program: the 600-series solid fuel rocket; the 601-series liquid propulsion rocket; and the 602-series ramjet powered missile. The missile was launched using combinations of three, four, or five rocket boosters that fell away after launch. The missiles ranged up to 16 ft in length, weighed about 5,000 pounds, and reached speeds of 1,500 mph. They had a high probability of kill up to 80,000 ft. The flight test phase for the Gapa began at Wendover Field in 1946 before the Boeing Aircraft Company moved its operations to AAAF. Program MX-606 had a total of 112 launches, 72 of which occurred at AAAF/HAFB. The first launch at AAAF occurred on 23 July 1947, with the last on 15 August 1950. In November 1949 a Gapa attained an altitude of 59,000 ft, the highest flight altitude for a supersonic ramjet propulsion system achieved up to that time. Although the Gapa never entered production, it paved the way for the later Boeing Bomarc (Boeing/Michigan Aeronautical Research Center) missile program (Mattson and Tagg 1995:17-19). The Bomarc was a pilotless aircraft designed for long range interception of enemy airplanes (Weitze 1997:28).

The Gapa launch complex consists of three intact structures, a firing apron, a possible magazine, and a number of features in a 600' x 900' area (Figure 59). Building 1139 was the observation shelter, with the designation Baker 2. A subterranean cable trench runs from the building to the 100 ft firing apron (Charlie 2) which supported the launch ramp. The cable trench continues to an unidentified depression cut into the side of the Lost River bank. The depression may have been a munitions magazine, although it is unlabeled on the 1947 General Plan for the Gapa Test Launching site. The complex also has a generator pad, switch house pad, and substation, all of which were unquestionably associated with the Gapa program. A number of other concrete pads, instrument stands, viewing platforms, and the possible footings for a portable launch ramp are situated in the vicinity of the observation shelter (Mattson and Tagg 1995:19-24). The exact uses for most of these latter features, and whether they were associated with the Gapa program, are unknown at this time.

The North American Test Instrument Vehicle (Nativ) complex was constructed 1,000 ft northeast of the Gapa complex. By October 1947, the complex included a blockhouse, static test stand, launch pad with a 125' tall steel tower, and conduit trenches (Weitze 1997:29). The Nativ (MX-770), designed by North American Aviation, was primarily a research vehicle but may also have been used for short range, surface-to-surface and surface-to-air ordnance delivery (AFMC [1953]). It began as a winged missile before the program was changed to a 1,000 mile test vehicle, followed by a 3,000 mile test vehicle, and then finally led to a 5,000 mile operational missile. Nativ testing took place in 1948, with static firings in January, the first flight in May, and the final launch during November. The test vehicle was about 14 ft long, weighed 1,260 pounds, had a range of 25 miles, and reached altitudes of 60,000 ft (Figure 60). It was powered by a liquid fuel rocket motor. Launch was accomplished from a 182' tall vertical tower (see Figure 6). The north and south legs of the tower sat on adjustable screw jacks, allowing it to be tilted as much as 15 to 18 degrees, although the usual tilt during launch was only 14 degrees (Figure 61). Vehicles were launched toward Mockingbird Gap approximately 50 miles to the north. The test stand accommodated static testing of motors before installation in the missiles (this served as North American's only static test stand for the Nativ in the U.S.). The Nativ program called for 20 flights, of which only six were successful. As a result of this program, which led to the X-10 test vehicles and Navaho XSM

Figure 59. Gapa launch complex map (HAR-041/LA 104274) with Building 1139 and associated features

Figure 59. Gapa launch complex map (HAR-041/LA 104274) with Building 1139 and associated features (adapted from Mattson and Tagg 1995:21).

Figure 60. Nativ (MX-770) missile being installed in launch tower, 1948

Figure 60. Nativ (MX-770) missile being installed in launch tower, 1948 (HAFB Environmental Flight, Cultural Resources Photo Archives).

Figure 61. Nativ (MX-770) missile launch at the moment of motor ignition, looking toward the Sacramento Mountains, 1948

Figure 61. Nativ (MX-770) missile launch at the moment of motor ignition, looking toward the Sacramento Mountains, 1948 (HAFB Environmental Flight, Cultural Resources Photo Archives).

(experimental strategic missile)-64, rockets were dropped as a means of cruise propulsion and were replaced by turbojets and ramjets (Mattson and Tagg 1995:25; Weitze 1997:29).

The Nativ launch complex consists of three intact structures, three firing aprons, and a number of features in a 400' x 600' area (Figure 62). Building 1116 (Baker 1) was the observation shelter with a subterranean, concrete-lined cable trench running north to a 40' square concrete static test pad. The trench continues to the 100' firing apron (Charlie 1), which once supported the 182' tall tilting launch tower. One concrete tower footing with the tilt mechanism still remains in place. A series of deluge, or fire plug features, are situated east of the firing apron. A second cable trench runs from Building 1116 to the JB-2 launch ramp, passing under a third probable concrete static test pad which may have been used for the later Falcon (MX-904) missile program (Figure 63). As with the Gapa complex, a generator pad, switch house pad (Building 1125), and substation are associated with the observation building. Building 1125, although intact, is actually a corrugated tin shack and is not listed on real property records. It is 4'8" x 6'9" x 8' with a doorway on the north side. Building 1127, a Rocket Motor Conditioning building, is also within the Nativ complex but is described later under Support Facilities. A number of other concrete pads and a concrete and stone culvert are situated in the vicinity of the observation shelter (Mattson and Tagg 1995:30-34). The culvert has a 1948 date inscribed in the concrete and was probably associated with the Nativ or JB-2 test programs. The uses of the remaining pads are unknown at this time, although at least one may have been associated with the later Falcon program. The Shrike-Rascal (MX-776) was also tested at the Nativ complex. The program shared the blockhouse and adapted the static test stand for use in horizontal ground static tests (Weitze 1997:45).

The JB-2 complex was the third constructed at the MTSA, although construction proceeded simultaneously with that of the Nativ and Gapa facilities. It was situated about 300 ft west of the Nativ complex to minimize new construction by taking advantage of the existing blockhouse and was planned for use in conjunction with a 40' long trailer ramp (HAFB 1948:28; Weitze 1997:31). The JB-2 Loon (MX-544) was the

American version of the German Vergeltungswaffe-1 (V-1: Reprisal or Vengeance Weapon), a guided missile carrying an explosive warhead. The JB-2 was 27'1 1/6" long, had a wing span of 17'8χ", weighed 5,025 pounds, and had a range of 150 miles and a ceiling of 6,000 ft (Figure 64). Republic Aviation Corporation in New York handled the weapons contract, and Northrop Aircraft Co. in California designed the launch sled. The test vehicle was launched from a ramp using a sled with four Rocket Assisted Take-off solid fuel boosters that dropped off after the rocket attained flight. The German V-1 can probably be considered the pioneer cruise missile. Research on the missile began in Germany in 1928, but full production did not begin until the war started to turn against the Nazis in 1942. Between June and September 1944, 5,430 V-1s were fired against England from northern France and Holland. The USAAF received salvaged remains of a V-1 in 1944 from either the underground forces in Europe or the British,

Figure 62. Map of the Nativ and JB-2 complexes (HAR-041/LA 104274) with Building 1116 and the JB-2 Ramp and associated features

Figure 62. Map of the Nativ and JB-2 complexes (HAR-041/LA 104274) with Building 1116 and the JB-2 Ramp and associated features (adapted from Mattson and Tagg 1995:31).

Figure 63. Falcon (MX-904) missile no. CW-73, with dummy warhead, installed on elevated launcher at the Nativ/JB-2 launch complex, 18 June 1952

Figure 63. Falcon (MX-904) missile no. CW-73, with dummy warhead, installed on elevated launcher at the Nativ/JB-2 launch complex, 18 June 1952 (HAFB Environmental Flight, Cultural Resources Photo Archives).

Figure 64. JB-2 (MX-544) installed on launch ramp, May-October 1948

Figure 64. JB-2 (MX-544) installed on launch ramp, May-October 1948 (HAFB Environmental Flight, Cultural Resources Photo Archives).

and in 17 days was able to reverse engineer the airframe and the engine. The first test flights for the American JB-2 took place at Eglin Field, Florida, in October 1944, with continued tests at Wendover AAF after the war. The program was transferred to AAAF in March 1947, but the first launch did not take place until May 1948 because the launch ramp was not completed. Program MX-544 was canceled before it moved to Alamogordo, but testing continued and 11 launches took place at the base with the last two in October 1948 (Mattson and Tagg 1995:35-39; Weitze 1997:30-31).

The JB-2 launch complex consists of the intact launch ramp and a number of features in a 200' x 500' area (see Figure 62). The 440 ft long ramp is inclined at a three degree slope and had a set of rails transported from Wendover AAF. The ramp has a concrete loading pit at the lower end, also used to deflect the blast, and a U-shaped reinforced concrete structure adjacent to the loading pit. The latter feature may have been used as protection for personnel during launch. Building 1116, the Nativ blockhouse, was used as the control center with firing controls and observation ports added for the program. A subterranean cable trench runs from this building to the north end of the ramp (Mattson and Tagg 1995:39; Weitze 1997:31, 44).

The ramp was modified and a number of associated features added at a later time for the Falcon program. Modifications made to the loading pit by Hughes Aircraft Company in the latter half of 1950 permitted the installation of a hot and cold chamber for temperature cycling of rocket motors used in the early stages of the program. The temperature-cycled rocket motors were then used during Falcon missile launches from a B-25 tied down to the right and just short of the northern end of the JB-2 Ramp (Mattson and Tagg 1995:43). In 1949, Hughes set up a rail launching track at the former Nativ site and built a service gallery to the rear of the planned launch track at the side of the JB-2 Ramp. The gallery supported the rail launcher for static tests of the missile and served as a checkout pit and personnel shelter in emergencies. A 20' x 25' missile assembly building was added at the launch site in the middle of the year. In 1950, Hughes continued modifications of the Nativ/JB-2 complex. A concrete pad was poured on top of the JB-2 Ramp and a wooden trestle loading ramp was constructed from the assembly building to the Falcon rail launch ramp. The gallery/protective shelter beneath the launcher was enlarged, and two concrete pads for a visual control radar station and a launcher control station were poured. Finally, concrete pads were poured for the B-25 planned for use in air launch Falcon tests and a static launcher was constructed. The latter consisted of a zero length launcher mounted on a 75 mm Howitzer cannon carriage (Weitze 1997:45, 53).

As 1948 drew to a close, Aerojet Engineering Corporation arrived at HAFB and began establishing the Aerobee rocket program. Construction of this fourth launch complex, located 1,000 ft southwest of the Gapa complex, began in mid-November and pads for the firing apron and blockhouse were poured by December (Weitze 1997:44). The Aerobee rocket program (MX-1011) was conceived in January 1946 with Aerojet as the prime contractor. The goal was to develop an upper air research vehicle sounding rocket with satisfactory parachute recovery systems for both the nose cone and the main body. Aerobee was considered essential to the improvement of control and guidance mechanisms for drones, weather control, biological studies, and bacteriological and atomic warfare (Mattson and Tagg 1995:45; Weitze 1997:44, 52).

The original Aerobee X-8 was a vehicle 19 ft long with a gross weight of 1,600 pounds (Figure 65). It was a single stage, unguided, spin-stabilized, liquid propellant rocket. A number of successive models followed, including the X-8A, X-B, X-C, and X-D. The Aerobee was launched, using a 6 ft long solid propellant booster, from a 143 ft tall tower elevated to an angle of 87 degrees. HAFB's first tower was only 60 ft tall, but by 1951 a new 152 ft tall tower had been installed on the firing apron. While the original rocket was under construction, a dummy Aerobee was launched from WSPG in September 1947. The first firing of the completed rocket was in November of that year. Further tests were completed at WSPG through 1948 and the first launch from HAFB was in December 1949 (Mattson and Tagg 1995:47-48; Weitze 1997:52, 71).

The first HAFB Aerobee ascended almost 60 miles above the earth and took the first color motion pictures of the earth's surface. Between 1949 and 1954, the Air Force launched 48 X-8 Aerobee rockets, which were used for photographic, solar radiation, biomedical (carrying mice and monkeys from the Aeromedical Field Laboratory), and atmospheric measurement tests. In 1955, the Air Force launched the second prototype of the test program, the Aerobee-Hi (MX-1961), and by 1959 the Aerobee 150, which was in test by the National Aeronautics and Space Administration (NASA). The first Aerobee-Hi, which was 23 ft long and carried extra fuel, reached a height of 123 miles. The final Aerobee launch at HAFB was in June 1959. Over 100 Aerobee rockets were eventually launched and it became the longest continuous rocket program in the U.S., spanning 37 years (Mattson and Tagg 1995:48-52, 138). The program set many records in aerospace history and carried "instrumentation aloft in a methodical exploration of the vertical frontier" (Weitze 1997:71).

The Aerobee launch complex consists of an intact control blockhouse, a firing apron, and 15 features in an 400' x 800' area (Figure 66). Building 1142 (Baker 3) was the observation shelter with a subterranean, concrete-lined cable trench running west to a 100 ft square firing apron (Charlie 3), which once supported the launch towers. A deluge system, including what appears to be a cistern, and a transformer vault are associated with the building. A number of other concrete pads, vaults, and metal instrument stands are situated in the vicinity of the observation shelter (Mattson and Tagg 1995:52-56). The use of these features or their association with the Aerobee program is unknown at this time. A number of the features are described below for the fifth launch complex.

Figure 65. Aerobee test vehicle (MX-1011) raised into firing position, before 1953

Figure 65. Aerobee test vehicle (MX-1011) raised into firing position, before 1953 (HAFB Environmental Flight, Cultural Resources Photo Archives).

Figure 66. Aerobee launch complex map (HAR-041/LA 104274), with Building 1142 and associated features

Figure 66. Aerobee launch complex map (HAR-041/LA 104274), with Building 1142 and associated features (adapted from Mattson and Tagg 1995:53).

The fifth and final complex constructed on the MTSA was apparently never used. In the mid-1950s, HAFB was chosen as a missile development center for the ICBM. This project would result in a massive build-up of research and development facilities on the base. The decision was partially based on HAFB's ideal climate and sparsely populated area, and also on President Eisenhower's dispersal or California policy which stipulated that future missile development be conducted away from the seacoasts. Unfortunately, the decision was overturned in 1956 and Vandenberg AFB in California was given the assignment to begin testing the Atlas-A ICBM. The Rocket Engine Test Branch at Edwards AFB, California, also began Atlas testing in 1956 at Test Stand (TS) 1-A, the first facility where the complete missile system could be tested. The first Atlas models were tested at these bases in a wet pad configuration. They were not actually launched, but held in place within a large, steel superstructure for what were termed tie-down, or captive tests. During the test, the concrete pad beneath the tower and missile was deluged with water at its flame deflector water tank/bucket to keep the bucket sufficiently cool for sustained use and help suppress sound. The deflector/bucket channeled the contaminated water and toxic exhaust into a trench running to an arroyo away from the test pad superstructure (Kilanowski et al. 1993: 6-7, 13-16; Weitze 1997:77-81).

A possible Atlas test site was identified recently by Weitze (1997) within the Aerobee launch complex (see Mattson and Tagg 1995:54). The Test Stand, assessed during the current project, is at the far north end of the Aerobee complex. It consists of a 20' x 50', two story concrete structure set into the bank of an erosional channel leading into Lost River. At least one sidewalk-like concrete pad 80 ft to the south and also within the Aerobee complex may be associated with the test stand. Weitze (1997:81) states that the Test Stand is:

> . . . characterized by its flame bucket cavity; its earthen exhaust trench into an arroyo; and its flanking fuel storage pocket. Although this structure is approximately 40 percent the size of the Atlas-A launch pad, it is distinctive in its components for Thor/Atlas wet tie-down testing, suggesting a prototypical static test stand. The launch pad may be an unfinished Thor/Atlas *components* static test stand. Drs. [Ernst] Steinhoff and Ernst Lange had jointly written *Test Stand for Static Testing of*

> *Rocket*[:] *Recommendations for its Completion* by mid-April 1955, a document that may relate to this facility as well. In late 1956, four such test stands were still authorized for Holloman, with construction of support facilities underway. The project was halted in 1957.

Photographs of TS 1-A at Edwards AFB support Weitze's identification of the HAFB Test Stand. The facility consists of a tall metal tower sitting on, and at the end of, the concrete flame deflector, which extends out from a ridge over a drainage. A 1957 photograph of an Atlas hot firing test shows flames and exhaust coming out of the bottom of the concrete flame deflector (Kilanowski et al. 1993:4-11). The HAFB Test Stand is an almost identical, albeit much smaller, version of the TS 1-A flame deflector in both appearance and its location over an arroyo.

Building 1116

Building 1116, completed ca. 1947 as a Missile Launching Test Facility at the MTSA, was the observation shelter for the Nativ test vehicle (see Figure 12 and Appendix C). The real property records indicate a 1949 completion date for the building, but this would have been after the Nativ program ended at HAFB. It is a permanent, one story, monolithic blockhouse showing a rectangular footprint and a steeply pitched, truncated hip roof (Figure 67). The building was constructed completely of reinforced concrete. The walls and roof were 3' thick reinforced concrete with a 6' wide reinforced wall footing and a 6" slab on grade foundation. The building is listed as being 21' x 34' with an 11' x 12' offset (portico) and 891 SF of interior space. Changes in size included the loss of 45 SF (through 1957) for a final total of 846 SF. A real property listing under Lease #67 indicates a 7'6" x 12' (90 SF) door shelter that may have been added at a later time. Listed functions for the building include Lease #67 (function and date unknown); Missile Launch Facility (ca. 1962); Research Equipment Storage (ca. 1975); and Morale, Welfare and Recreation MWR) Supply and Nonappropriated Funds (NAF) Central storage (ca. 1991). It is currently vacant (Facility Assessment Form/1116; Mattson and Tagg 1995:30; Real Property Accountable Record/1116).

An original 1947 drawing shows the one room structure with a portico wall, entrance door, four windows, and an observation deck (Figure 68). The building measures 21' x 34' with the portico sitting on an 11'1" x 23'9" concrete pad. The sole entrance faces south and is centrally located beneath the concrete portico. The single-hung 4'2" x 7'2" door is constructed using a 1:" wood core reinforced on both sides using 3/16" thick steel plate sheathing. The door swings outward on δ" x 22" x 24" long steel strap hinges. The observation windows are stepped and blast proof; three are located at the north facade and the fourth faces west. The blast proof glass pane (1' x 2' x 5" thick) is cushioned using 3" sponge rubber against steel retainers set in stepped-back concrete. The observation deck, enclosed by a metal pipe rail, is situated on the flat roof top. This deck is accessed by steel, bent rod "manhole" steps that ascend the center of the east elevation. A 10' square concrete pad runs east of the entryway and exterior instrument control boxes are located at ground level below each of the northern windows. A concrete cable trench runs north from one of these boxes to the static test stand and firing apron, and a second trench runs northwest to the north end of the JB-2 launch ramp. Notable original features in the facility included a bulldog trolley system with chains and an angle iron track, 10' high reinforced ceiling using ε" x 18" x 24" steel plates attached to steel I-beams, a beveled wood sleeper embedded at the interior wall perimeter at a height of 4', and an instrument console and other equipment. The original drawings indicate R. Johnston prepared them for North American Aviation, Inc. (Englewood, California). The builder is unknown (Facility Assessment Form/1116; Mattson and Tagg 1995:30; Real Property Accountable Record/1116).

Figure 67. Building 1116, Nativ blockhouse in early 1948, looking south

Figure 67. Building 1116, Nativ blockhouse in early 1948, looking south (HAFB Environmental Flight, Cultural Resources Photo Archives).

Figure 68. Building 1116, floor plan of the Nativ blockhouse, ca. 1947

Figure 68. Building 1116, floor plan of the Nativ blockhouse, ca. 1947.

Building 1116 retains its one story scope, rectangular footprint, and steeply pitched truncated hip roof. The building also maintains historic integrity: no structural modifications were noted and the facility remains essentially as it was originally constructed. The blast proof windows have bullet holes in them and there is spray paint graffiti on the building. With the exception of the track for the interior trolley system, all interior equipment has been removed (Figure 69). The original static test and launch towers have been dismantled (Facility Assessment Form/1116).

Figure 69. Interior of Building 1116, the Nativ blockhouse, showing instruments and military personnel during countdown, ca. 1948

Figure 69. Interior of Building 1116, the Nativ blockhouse, showing instruments and military personnel during countdown, ca. 1948 (HAFB Environmental Flight, Cultural Resources Photo Archives).

The building is located north of the Main Base in a locale identified as a launching area on a 1957 base map and locally known as the MTSA (see Figure 12). Contemporary facilities and features, such as the JB-2 Ramp, static test pad and firing apron, and numerous concrete pads still remain in the vicinity. The building has unique design characteristics as a blast and vapor proof blockhouse, and was used for its original purpose until missile testing ended at HAFB in the late 1950s. Since that time, it has been vacant or used for storage. Although currently abandoned, this building continues to exhibit its historic characterize a blast proof observation blockhouse and retains its integrity of association with early Cold War missile testing (Facility Assessment Form/1116).

<u>Building 1139</u>

Building 1139, completed ca. 1947 as a Missile Launching Test Facility in the MTSA, was the observation shelter for the Gapa test vehicle (see Figure 12 and Appendix C). The real property records indicate a 1951 completion date for the building, but this would have been after the Gapa program ended at HAFB. It is a permanent, one story, monolithic blockhouse showing a rectangular footprint and a steeply pitched, truncated hip roof (Figure 70). The building was constructed completely of reinforced concrete: the walls of the observation room are 2' thick and those of the equipment room are 8" thick; the roof is 2' thick for the observation room and 6" thick for the equipment room. The foundation is a continuous wall footing. The building is listed as being 20' square (observation room) with a 13' x 20' offset (equipment room) and contains 660 SF of interior space. A real property listing under Lease #67 indicates two notations of “Open 152” and “96 Vest.” The meaning of these notations is not known. Notable original features in the facility include steel clad personnel doors, blast proof windows, and a unique ventilation shaft. Listed functions for the building include Lease #67 (function and date unknown), Missile Launch Facility (ca. 1962), Base Supply and Equipment Warehouse (ca. 1982), Security Police Operations (n.d.), and Research Equipment Storage (ca. 1990). A letter in the real property file also indicates it was used by HSTT personnel for storage ca. 1987. It has been used as a MWR Supply and NAF Central

Storage facility since 1992 (Facility Assessment form/1139; Real Property Accountable Record/1139).

Original 1947 drawings show the two room structure with two entrance doors, four inset windows, and an observation deck (Figure 71). The building measures 20' x 33', including the observation and equipment rooms. The observation room supports the truncated hip roof, with a steel-framed observation deck situated along the entire roof ridge. It is accessed by steel bent rod manhole steps that extend up the northeast elevation of the equipment room to a hand rail on the roof, and then continues up the west slope of the pitched observation room roof. A single wall and roof canopy constructed of 18" thick reinforced concrete protects the southwest single-hung access door. This observation room door is constructed using 2" x 4" tongue-and-groove lumber sheathed on both sides using 3/16" steel plates. Strap hinges δ" x 22" x 24" long are attached to a steel angle embedded in the concrete wall with welded bolts. Four 4" thick trapezoidal blast proof observation windows are set into a stepped rectangular opening at the north elevation. The windows are framed in a 3" steel plate bolted to steel angles embedded in the concrete wall. The equipment room is attached to the northwest elevation of the observation room. It has a low pitched shed roof, and a single-hung metal door centered at the southwest elevation. A 6' wide concrete pad runs along the front of the building, a 1'6" square concrete box is attached to the southeast elevation of

Figure 70. Building 1139, as an MWR Supply and NAF Central Storage facility in 1997, northeast and southeast elevations

Figure 70. Building 1139, as an MWR Supply and NAF Central Storage facility in 1997, northeast and southeast elevations (photo by A1C Colette Horton, HAFB Photo Lab, December 1997).

the observation room, and an instrument control box is located on the northeast elevation of the equipment room. A concrete-lined cable trench runs northeast from the building to the firing apron. The original construction plans were prepared by Boeing Aircraft Company (Seattle, Washington) but are not stamped as-built. The builder is unknown (Facility Assessment Form/1139; Mattson and Tagg 1995:19-22).

Building 1139 retains its one story scope, rectangular footprint, and steeply pitched and truncated hip roof. The building maintains historic integrity: no structural modifications were noted and the facility remains essentially as it was originally constructed. Aside from a metal plate covering the ventilation louvers, all the essential elements of original workmanship remain. All interior equipment and the associated launch tower have been removed. The building is located north of the Main Base in an area identified as a

Figure 71. Building 1139, floor plan of the Gapa blockhouse, ca. 1947

Figure 71. Building 1139, floor plan of the Gapa blockhouse, ca. 1947.

launching area on a 1957 base map and locally known as the MTSA (see Figure 12). Contemporary facilities and features such as the JB-2 Ramp and Nativ launch complex, the firing apron, and numerous concrete pads still remain in the vicinity. The building was used for its original purpose until missile testing ended at HAFB in the late 1950s. Since that time it has been vacant or used for storage and Security Police operations. Currently used as a storage facility, this building continues to exhibit its historic character as a blast proof observation blockhouse and retains its integrity of association with early Cold War missile testing (Facility Assessment Form/1139).

Building 1142

Building 1142, completed ca. 1949 as a Missile Launching Test Facility in the MTSA, was the observation blockhouse for the Aerobee rocket (see Figure 12 and Appendix C). Real Property records indicate a 1950 completion date. It is a permanent, one story, monolithic blockhouse showing an irregular footprint and a steeply pitched and truncated hip roof (Figure 72). The building was constructed completely of reinforced concrete: the walls of the observation room are 2' thick and those of the equipment room are 8" thick; the observation room roof is 2' thick and that of the equipment room is 5" thick. The foundation is a continuous wall footing. The building is listed as being 24' x 28' with offsets of 9' x 25' and 10' x 14' and a Tri (meaning unknown) of 5' x 10'. It contains 1,087 SF of interior space. A real property listing under Lease #67 indicates a notation of "126' Open (9 x 14)." The meaning of this notation is not known. Notable original features in the facility include the blast proof windows. Listed functions for the building include Lease #67 (function and date unknown) and Missile Launch Facility (ca. 1962). It is currently used as a Retail Warehouse for the Base Exchange (Facility Assessment Form/1142; Real Property Accountable Record/1142).

Original 1948 drawings shows the two room structure with four entrance doors, three sets of four windows flush to the walls, and an observation deck (Figure 73). The building measures 32'6" x 38': the observation room is 24'6" x 32'6" with the west wall 14'10" long, northwest wall 13'8", and north wall 22'10"; the utility room is 13'6" x 23'6" and includes an enclosed latrine with access only from the outside. The main observation room is roughly rectangular with the northwest corner at a 45, rather than 90 degree angle. It supports the high truncated hip roof. The observation deck is formed by the flat top of this roof. It has a steel pipe railing and is accessed by a metal ladder ascending the east elevation and roof of the room. Three sets of four square inset windows with $2\frac{3}{32}$" thick blast proof glass face west toward the firing apron, northwest, and north. Two single-hung metal personnel access doors open onto a concrete sidewalk to the south and east. A 5' square concrete pull box adjacent to the west elevation provides the beginning for the concrete-lined cable trench running west to the firing apron. A rectangular equipment/utility room adjoins the south elevation of the observation room. It has a slightly pitched shed

Figure 72. Building 1142 as a Base Exchange Retail Warehouse in 1996, north and west elevations

Figure 72. Building 1142 as a Base Exchange Retail Warehouse in 1996, north and west elevations.

roof, two single-hung steel personnel doors opening onto a concrete patio to the east (one providing access to the latrine), and a large (8' x 7') aluminum slider equipment door opening onto a concrete pad to the west. An evaporative cooler is attached to the roof. Access to the interior was not gained, so it is unknown if any original equipment or features remain intact. The original architectural drawings were provided by the Aerojet Engineering Corporation (Azusa, California). The builder is unknown (Facility Assessment Form/1142; Mattson and Tagg 1995:52).

Building 1142 retains its one story scope, irregular footprint, and steeply pitched truncated hip roof. The building maintains historic integrity: no structural modifications were noted and the essential elements of original workmanship remain visible. The blast proof windows are pocked with bullet holes. Spray paint graffiti mars exterior walls and the observation deck is piled with deteriorating sand bags, suggesting the facility was used during a military maneuver. The slider door to the utility room is badly bent inwards (Facility Assessment Form/1142; Mattson and Tagg 1995:52-54). The associated launch tower was moved to WSMR ca. 1965 (Bob Burton, WSMR Archaeologist, personal communication 1997).

Figure 73. Building 1142, floor plan of the Aerobee blockhouse, ca. 1948

Figure 73. Building 1142, floor plan of the Aerobee blockhouse, ca. 1948.

The building is located north of the Main Base in an area identified as a launching area on a 1957 base map and locally known as the MTSA (see Figure 12). Contemporary facilities and features, such as a relatively intact Test Stand (discussed later), the firing apron, and numerous concrete pads, still remain in the vicinity. The building was used for its original purpose until missile testing ended at HAFB in the late 1950s. Since that time, it has been vacant or used for storage. Currently used as a storage facility, this building continues to exhibit its historic character as a blast proof observation blockhouse and retains its integrity of association with early Cold War missile testing (Facility Assessment Form/1142).

JB-2 Ramp

The JB-2 launch ramp was completed ca. 1947 in the MTSA (see Figure 12 and Appendix C). The structure does not have a facility number and no real property records were located. The structure consists of a long, earthen ramp (Figure 74). Without a Real Property Accountable Record, there is no record of functions for the ramp after the JB-2 test program ended in 1948. Archival research by Mattson and Tagg (1995) and Weitze (1997) indicate the ramp was modified for other missile testing in 1949 and 1950. As described earlier, Hughes Aircraft Company is apparently responsible for the modifications of the loading pit and the addition of the concrete and wooden features at the north end of the ramp, as well as for many of the concrete pads on either side of the ramp. Currently the JB-2 Ramp is abandoned.

Figure 74. JB-2 Ramp in 1995, west profile

Figure 74. JB-2 Ramp in 1995, west profile (HAFB Environmental Flight, Cultural Resources Photo Archives).

Original 1947 drawings show a 440' long earthen ramp with a concrete loading pit (Figure 75). The ramp ranges in width from 10' at the south end to 80' at the north end and faces 330 degrees. The ramp bed is inclined at a 3 degree slope, starting at the existing ground level (south end) and rising to a height at the north end of approximately 24'. Two parallel, 75 pound ASCE (American Society of Civil Engineers) rails are set 4'11" apart and run for 392'2" along the top. The track sits on 18" tall steel I-beams resting on 77 standard 8" x 1' x 7' wood cross-ties. A bed of 10" thick reinforced concrete was poured over a compacted subgrade between I-beams. The rails were apparently transferred from JB-2 test facilities at Wendover AAF in Utah and used in the construction of this ramp. At the north end of the ramp a concrete stairway leads down to a 20' x 40' concrete pad cut into the ramp. The pad is elevated about 4' above the present ground surface with two sets of concrete steps running to the ground. A partially obscured, semisubterranean cable trench runs from beneath this feature southeast to Building 1116. A 5' x 10' concrete pad sits at the north end of the ramp beyond the rails, and 2" x 10" wood planks extend from this feature to a metal tower situated just off the end of the ramp. A wood flume runs from a channel between the end of the rails and this pad to three concrete pads situated below the ramp. A wooden stairway also runs off the west side of the ramp (Mattson and Tagg 1995:38-43).

The loading pit, situated at the south end of the ramp, is rectangular with a flared apron at the south end. The pit is 20' x 16' x 3'3" deep with 8" thick concrete walls and the apron is 20' long and 34' wide at its widest point. The pit was apparently once open to the south but has been enclosed with a concrete wall; a 6'4" x 5'4" entryway is now situated in the center of this wall. The height of the pit walls has also been extended 4', encasing the southern ends of the rails. A “reinforced concrete structure” is shown just west of the south end of the track by the loading pit (CE File IE 232). A 1948 photograph verifies this feature as being U-shaped (see Figure 64). An identical structure is now located on the east side of the track. It has 8" thick concrete walls and floor and inside dimensions of 6' x 4' x 4' deep (Mattson and Tagg 1995:39-43). The original architectural drawings, labeled as-built, were provided by the War Department, U.S. Army Corps of Engineers, Office of the District Engineer (Albuquerque, New Mexico). The builder is unknown.

The JB-2 Ramp retains its original size and shape and maintains historic integrity. Most of the original materials used to construct the earthen ramp are still visible, although some modifications have occurred. Only 105 ft of rail at the south end and a single rail in the center of the ramp remain intact. The remainder has been cut off and removed. The loading pit and north end of the track have been modified with concrete and wood features, and these features are deteriorating and responsible for erosion of the earthen ramp. The addition of these features has not obscured original workmanship, however. They contribute to the ramp’s early Cold War period of significance. The structure is located within an area identified as a

Figure 75. JB-2 Ramp; profile, plan view, and cross section, ca. 1947, and plan view with later modifications as it appeared in 1996

Figure 75. JB-2 Ramp; profile, plan view, and cross section, ca. 1947, and plan view with later modifications as it appeared in 1996.

a launching area on a 1957 base map and locally known as the MTSA (see Figure 12). Contemporary facilities and features such as Building 1116, which was used as the observation shelter for the JB-2 and Falcon missile programs, and numerous concrete pads and features still remain in the vicinity. The structure was used for its original purpose until missile testing was no longer conducted at the MTSA in the late 1950s. Since that time it has been abandoned. The structure continues to exhibit its historic character as a test vehicle launch ramp and retains its integrity of association with early Cold War missile testing (Facility Assessment Form/JB-2; Mattson and Tagg 1995:39).

<u>Test Stand</u>

The Test Stand is thought to have been completed around 1955 as a Captive Test Stand flame deflector water tank/bucket for Thor/Atlas wet tie-down testing (Weitze 1997). It is located in the MTSA (see Figure 12 and Appendix C). The structure does not have a facility number and no real property records or drawings were located. It is a rectangular concrete structure standing two stories above a drainage (Figure 76). Without a Real Property Accountable Record, there is no record of the original, or later, function for the structure. Archival research by Weitze (1997) indicates that the structure is distinctive in its components for Thor/Atlas wet tie-down testing, although there is no evidence that it was ever used for that function. Currently, the Test Stand is abandoned.

Figure 76. Test Stand in 1995, north and west elevations, with Aerobee blockhouse (Building 1142) in the background

Figure 76. Test Stand in 1995, north and west elevations, with Aerobee blockhouse (Building 1142) in the background (HAFB Environmental Flight, Cultural Resources Photo Archives).

A drawing of the structure was completed when the archaeological site was first recorded (O'Leary 1994). This drawing was field checked and updated for the current project. The structure measures approximately 20' x 47' x 16' and consists of a concrete slab platform (two pads) at ground level covering a two section manhole (Figure 77). It is constructed completely of concrete with a slab foundation and footings, cast-in-place concrete walls, and a reinforced 6 inch concrete slab roof.

The structure extends over an arroyo, with a 15' section of the top slab at the eastern end situated directly on grade. Two 10' long retaining walls extend perpendicular to the slab at the point at which the grade steepens. A 23' long middle portion is supported by parallel concrete walls, about 5' apart, below the slab. A perpendicular wall bisects the middle section into two sections. A 9' section at the west elevation is supported by cantilevered concrete beams. A round opening on the roof deck provides access to the manhole and steel bent rod 'manhole' steps descend the wall between the sections. A small doorway or opening is in the wall between the 11' x 7'3" x 6' sections. The floor is poured concrete at an elevation 6' below the bottom of the roof slab. Numerous iron plates and conduit sleeves are in the platform and "WDN 4/11/64" and "64 HORST" are inscribed in the western pad. A large 5' x 6' metal plate covers a U-shaped opening on the Test Stand deck. The remains of a metal pipe railing are on the southwest corner of the pad. Metal pipe supports run south from the structure to concrete conduit sleeves set in the channel bank. A deteriorated wooden walkway is located at the north elevation. The arroyo appears to have been dammed to hold water, and scattered lumber below the walkway indicates that a structure, perhaps a tower, once stood in that location (Facility Assessment Form/Test Stand; Mattson and Tagg 1995:54).

Although not verified through documentary evidence, the concrete Test Stand appears to be essentially intact and is thought to maintain historic integrity. A pipe railing at the center section of the structure has been removed and a possible wooden structure has collapsed. Trash has been deposited through the large circular opening into the manhole rooms. The structure is located within an area identified as a launching area on a 1957 base map and locally known as the MTSA (see Figure 12). Contemporary facilities and features, such as Building 1142 (Aerobee observation shelter) and numerous concrete pads, still remain in the vicinity. The structure is in a direct line with the observation windows of Building 1142 and may be associated. The structure continues to exhibit its historic character as a test stand, may be a prototypical type, and retains its integrity of association with early Cold War missile testing (Facility Assessment Form/Test Stand; Mattson and Tagg 1995:54).

Figure 77. Test Stand plan view in 1996

Figure 77. Test Stand plan view in 1996.

Able 51/ZEL Site: Buildings 1440 and 1442

By 1957, the major guided missile and experimental test programs of the late 1940s and early 1950s had completed their ground launch testing, with the exception of the Aerobee. The focus at HAFB during the late 1950s was on air-launched guided missiles, target drones, and components testing planned for the HSTT. The only ground-launched vehicle tested during this time was the Mace (Tactical Missile [TM]-76A), which was launched from a sheltered zero length "hardsite" called the ZEL (ZEro Length) site, Able 51, or BQM-34A Drone Launch site (Mattson and Tagg 1995:56; Weitze 1997:85-87) (Figure 78). Two intact buildings, 1440 and 1442, and numerous concrete pads remain at this launch facility. The facility is discussed in length by Mattson and Tagg (1995).

During the 1950s, before ICBMs were developed, the principal Cold War threat was from manned bombers. Fighter aircraft, which needed long runways for take-off, were the best counter for this threat. If an enemy bomber broke through the U.S. defenses, it could wipe out the fighter force and runways. In addition, Allied forces in Germany needed the ability to launch fighters from unprepared airfields without long, highly visible runways. The U.S. began developing the ZEL launcher in response to these threats and needs. After unmanned tests, the USAF launched its first successful manned aircraft: F-84 from a mobile launcher at Edwards AFB in 1953. The mobile launchers were strategically sound because they could be moved to different areas and thus would be hard for the enemy to track. Because USAF officials did not think the German civilian population would appreciate nuclear weapons being trucked around their countryside, they decided to create a shelter for the ZEL launchers (Mattson and Tagg 1995:57; Smithsonian Institution 1995).

The first simulated atomic blast proof shelter was constructed on HAFB. The launch facility, Building 1442, was constructed to withstand the overpressure resulting from an atomic bomb explosion. The hardsite would protect the fighter parked in the structure, and a ZEL launcher would catapult the aircraft into the air to meet the next wave of enemy bombers without need of a runway. The ZEL launcher was similar in function to those used on Navy aircraft carriers. The launcher elevated the fighter's nose to a 15 degree angle and the thrust of a rocket motor attached to the plane's fuselage, combined with the thrust from the fighter's jet engine, propelled the munition-laden aircraft into the air (Mattson and Tagg 1995:57; Smithsonian Institution 1995).

Figure 78. Mace missile (TM-76A) launch from Able 51/ZEL site (Building 1442), 12 May 1959

Figure 78. Mace missile (TM-76A) launch from Able 51/ZEL site (Building 1442), 12 May 1959 (HAFB Environmental Flight, Cultural Resources Photo Archives).

The ZEL facility was used primarily for testing the Mace missile, although the Matador missile and the BQM-34A Firebee drone were also launched from mobile launchers tied down to concrete pads at the site (Figure 79). In August 1959, a manned F-100 fighter with a 130,000 pound thrust Astrodyne solid fuel rocket booster was launched from Building 1442 using the ZEL launcher. The combination of the booster rocket motor and jet engine thrust boosted the F-100 to a speed of 300 mph and an altitude of 350 ft in just six seconds. Another F-100 was successfully launched during a night test, but then testing was discontinued at Able 51. The ZEL program continued, though, with mobile launches of F-104s by the German Air Force in Germany. ZEL-launched fighters never became an operational program in the U.S. The need for such launchers became obsolete with the development of long range bombers and ICBMs that could be launched from the U.S., and nuclear submarines that could maneuver within firing distance of the U.S.S.R. (Mattson and Tagg 1995:57; Smithsonian Institution 1995).

Figure 79. Matador missile (TM-61) on a mobile transporter/launcher at Eglin AFB, Florida, ca. 1951

Figure 79. Matador missile (TM-61) on a mobile transporter/launcher at Eglin AFB, Florida, ca. 1951 (HAFB Environmental Flight, Cultural Resources Photo Archives).

The Mace missile began as the Martin B-76, but underwent a nomenclature change to TM-76A. It was a long range surface-to-surface missile and an advanced version of the Matador pilotless bomber (AFMDC [1953]:1-4). The Mace was 44' long, had a wing span of 22'11", and weighed 18,000 pounds (see Figure 78). Launch was accomplished at a 19 degree angle by the combination of a jet engine and solid rocket booster that generated 50,000 pounds of thrust. Missiles were checked out in a missile assembly building (Building 1264), and trucked to the ZEL site where they were hoisted onto the launcher. The fixed launcher in the ZEL facility, as well as mobile launchers, were used. A concrete, semisubterranean blockhouse, no longer in existence, was used as the launch control. Later programs used Building 1440 for this purpose (Mattson and Tagg 1995:58-59).

The Matador, which was actually a pilotless aircraft, was the first USAF missile to reach operational status in the 1950s. It was a very low altitude, high supersonic, surface-to-surface missile which had been tested at HAFB since the late 1940s and became operational in 1955 (AFMDC [1953]:1-4; Weitze 1997:39). The Matador had various project designations including MX-771, XB (experimental bomber)-61, TM-61, and Martin B-61. The various versions of the Matador were between 39'9" and 45'10" long, weighed 12,000 to 13,000 pounds, and had a wing span of 28'10" (see Figure 79). They were powered by a jet engine that produced 4,600 pounds of thrust. Boosters, giving 50,000 pounds of thrust, were used during the launch phase. Matadors were launched from mobile launchers tethered to concrete pads just north of Building 1440, the launch control blockhouse. Fixed launchers were considered vulnerable to enemy attacks, so mobile launchers were developed. The transporter/launcher resembled the flatbed trailer of a tractor trailer. A ZEL launcher held the missile during transportation, then would be elevated to give a positive angle of attack for launch. Missiles on these mobile launchers could be transported to any location; there is also photographic evidence that the Matador was launched from the MTSA (Mattson and Tagg 1995:59-60; Weitze 1997:25, Table 2).

After the Matador and Mace missiles became operational, crews were brought to HAFB for training. One type of launch training consisted of "Rapid Fire," or lining up four missiles for firing in tandem. Missiles from the ZEL site were fired to places as distant as Wendover, Utah, with no problems. Unfortunately, the potential for mishap was considered high, which probably led to the program being transferred to Cape Canaveral, Florida, where long range firings could be safely conducted over the sea. As the Matador and Mace programs ended, Able 51 was used as the launch point for the BQM-34A target drone (Mattson and Tagg 1995:59-61).

The BQM-34A Firebee was a pilotless, turbojet, high speed, remote controlled aerial target designed to simulate a jet fighter for antiaircraft and air-to-air gunnery training (AFMDC [1953]:1-4). The drone was 23' long, had a swept back wing span of 12'11", and weighed about 2,500 pounds (Figure 80). It was launched using a solid rocket booster in conjunction with the jet engine. The drone could reach a speed of Mach 0.9 and an altitude of 55,000 ft. After launch it was remote controlled from the King-1 control station two miles to the northeast of Able 51. Two launchers were used at Able 51, located on the concrete pads between Buildings 1440 and 1442. One was known as a fixed launcher because it was permanently mounted by bolts set in the concrete. The second was known as the mobile launcher because it could be towed to any location on HAFB and WSMR and put into operation in a short period of time. By the late 1970s, the drone function at HAFB was abolished and the use of Able 51 as a test facility ended (Mattson and Tagg 1995:61-62).

Figure 80. A Firebee jet target drone blasts off from its launch pad in front of Building 1442 at Able 51/ZEL site, Holloman AFB, 1960s

Figure 80. A Firebee jet target drone blasts off from its launch pad in front of Building 1442 at Able 51/ZEL site, Holloman AFB, 1960s (HAFB Environmental Flight, Cultural Resources Photo Archives, Emily K. Lovell collection, no date).

Able 51 (HAR-075/LA 107799) consists of two intact buildings and 32 features in two loci within a 980' x 1,210' area (Figure 81). Building 1442, the hardsite, was constructed in 1959 as the missile launch facility for the F-100 and Mace missile. A concrete pad with an iron cover extends in front of the open shelter and was probably a base for a mobile or fixed launcher. A demolished, semisubterranean control blockhouse just south of the launch building was the original control building. Building 1440, replacing the function of the demolished blockhouse, and two concrete launch pads were constructed between 1960 and 1962. The concrete pads and iron tie-downs adjacent to the building were for fixed and mobile launchers for the BQM-34A. The 75' diameter concrete Matador launch pad lies approximately 200 ft north of Building 1440. A subterranean cable trench runs from Building 1440 to the launch pad, suggesting that later Matador launches were controlled from that building. An isolated concrete pad located more than 200 ft south of Building 1442 may have been a launch facility for Matador and Mace missiles (Mattson and Tagg 1995:62-66).

<u>Building 1440</u>

Building 1440, completed in 1962 as a Missile Launch Facility at Able 51, was an observation blockhouse for Mace and Matador missiles and drone launches (see Figure 12 and Appendix C). It is a permanent, one story, flat roofed building with a rectangular footprint (Figure 82). The building was constructed of concrete with a continuous wall footing, block walls, and roof. The floor was tile. The building is listed as being 15'6" x 22' with 279 SF of interior space. In 1963, 62 SF were added for a final total of 341 SF. No interim functions were noted on the real property form, although letters in the building file indicate it was used as a Satellite Communications work center (ca. 1987) and for Trainer Container (ca. 1989) and Heavy Repair Equipment storage (ca. 1994). It was also used briefly for Air Force Office of Special Investigations evidence storage in 1996. It is currently a storage facility for the Civil Engineer Squadron Environmental Flight (Facility Assessment Form/1440; Real Property Accountable Record/1440).

The earliest drawing (1962) shows the structure with a doorway opening over a concrete landing at the northeast elevation and five windows on the southeast elevation (one window wraps around the corner to the southwest elevation) (Figure 83). The building measures 15':" x 22'22". It has 82" thick concrete walls, narrow rectangular window slots at all elevations (five at the southeast elevation [1962], one northeast, two northwest, and two southwest [later additions]), and a single-hung metal door at the northeast elevation. Original drawings were not located, so neither the architect nor the builder is known (Facility Assessment Form/1440; Mattson and Tagg 1995:63).

Figure 81. Map of Able 51/ZEL complex (HAR-075/LA 107799) with Buildings 1440 (Feature 16) and 1442 (Feature 11) and associated features

Figure 81. Map of Able 51/ZEL complex (HAR-075/LA 107799) with Buildings 1440 (Feature 16) and 1442 (Feature 11) and associated features (adapted from Mattson and Tagg 1995:64).

Figure 82. Building 1440, as a Civil Engineer Environmental Flight storage facility in 1996, northeast and southeast elevations, with Building 1442 in the background

Figure 82. Building 1440, as a Civil Engineer Environmental Flight storage facility in 1996, northeast and southeast elevations, with Building 1442 in the background.

Building 1440 retains its one story scope, rectangular footprint, and flat roof. The building maintains historic integrity, although improvements were made to the building soon after it was constructed. The original building was extended in length by approximately 4 ft ca. 1962. A raised floor, interior finishes, and southeast window slots were also added at that time. The interior walls were covered using wrapped gypsum panels as part of 1963 improvements to the building, and vinyl flooring has been added. Five windows slots were added at the northwest, northeast, and southwest elevations. Nearly all original window glass has been replaced with Plexiglass®. A cooling and heating system was added at the exterior and interior in support of its current function. All interior equipment has been removed (Facility Assessment Form/1440).

The building is located southwest of the Main Base at the Able 51 launch complex (see Figure 12). Contemporary facilities and features such as the Building 1442 hardsite, concrete pads for mobile launchers, and numerous other concrete pads and features still remain in the vicinity. The building has been used for storage or has been vacant since missile testing ended at Able 51 in the early 1970s.

Figure 83. Building 1440, floor plan of Able 51 observation shelter, ca. 1962

Figure 83. Building 1440, floor plan of Able 51 observation shelter, ca. 1962.

Currently used as a storage facility, this building continues to exhibit its historic character as an observation blockhouse and retains its integrity of association with early Cold War missile testing (Facility Assessment Form/1440).

Building 1442

Building 1442, located at Able 51, was completed ca. 1959 as a Missile Launch Facility for the Mace and Matador missiles (see Figure 12 and Appendix C). It is a permanent building, consists of two large open bays, and has an almost square footprint (Figure 84, see Figures 78 and 82). The building was originally constructed with a concrete slab floor and isolated bent column footings. The walls and roof are corrugated metal; the roof has steel panels at the interior. The building is listed as being 62'8" in x 74' with 4,638 SF of interior space (Facility Assessment Form/1442; Real Property Accountable Record/1442). No interim functions were noted on the real property form, although the building was used from ca. 1986 to 1995 to store transformers awaiting polychlorinated biphenyl (PCB) analysis (Bill Ford, 49 CES/CEV, personal communication 1997). It is currently vacant.

Figure 84. Multiple photo sequence of Mace missile (TM-76A) launch from Building 1442, ca. 1959, northeast and northwest elevations

Figure 84. Multiple photo sequence of Mace missile (TM-76A) launch from Building 1442, ca. 1959, northeast and northwest elevations (HAFB Environmental Flight, Cultural Resources Photo Archives).

No drawings were located for the facility, but one drawn for the original project was field checked and modified for the current project. The building measures 64'52" x 74'52" with the smaller bay 30' wide and the larger bay 44'52" wide (Figure 85). A three dimensional cross section shows the slanted, mansard-like roof shape. The building is constructed of steel bents forming two bays and is clad with corrugated metal. The cross section of the two bays consists of a smaller steel bent next to, and sharing the interior leg of, a larger steel bent. Two bends in each leg form the flat roof and the top angle. The steel bents increase in height from the rear to the front of the structure, creating an angled roofline along the long axis. The steel bents are exposed and are sheathed using χ" steel corrugated panels. The bays are enclosed at the rear (southeast) elevation by a heavy steel plate attached to steel framing. These plates show a circular opening where 8' diameter blast tubes were attached. The front elevation (northwest) of each bay is open. Two standard steel single-hung access doors each are located at the northeast and southwest elevations and three are at the interior, adjoined, wall between the bays. One doorway on the southwest elevation is approximately 5' above the ground; the three interior doors are situated ca. 2' (n=2) and 5' above the ground, with the latter door opening to a steel platform. Metal ladders access small vent openings with steel railed, wooden floor platforms near the roof at the northeast and southwest elevations. Because no drawings were located the architect and builder are unknown (Facility Assessment Form/1442; Mattson and Tagg 1995:63).

The building is fronted by a 28' x 76' concrete pad with a 12' x 14' extension to the north and a 10' x 38' iron plank and subterranean cable trenches in the center. A network of concrete cradle segments and iron braces is located at the rear (southeast) elevation. These once supported the metal blast (exhaust) tubes, which would have extended 49 ft from the larger bay and 86 ft from the smaller bay; three sections of the tube still exist at the smaller bay. A sidewalk and concrete-lined trench with an iron track run south from the building to a demolished blockhouse (Mattson and Tagg 1995:63).

Building 1442 retains its large, open bay scope, square footprint, and slanted, mansard-like roof shape. The building maintains all aspects of historic integrity and the basic structure remains essentially intact. Large sections of the blast tubes, interior bracing, most of the batt insulation, and steel mesh enclosure panels have been removed. Sheared bolts in the floor indicate unknown interior elements, such as launchers, have also been removed. The interior of the facility and many concrete features in the area were covered with spray painted graffiti. The majority of this was painted over in 1997 using silver paint on the corrugated metal and concrete and rust paint on the iron doors and blast tubes. All openings are now enclosed by chain link gates or fencing (Facility Assessment Form/1442).

Figure 85. Building 1442, floor plan and 3-D profile of Able 51/ZEL site launch facility, ca. 1994

Figure 85. Building 1442, floor plan and 3-D profile of Able 51/ZEL site launch facility, ca. 1994.

The building is located northwest of the Main Base at the Able 51 launch complex (see Figure 12). Contemporary facilities and features such as the Building 1440 observation shelter, concrete pads for mobile launchers, and numerous other concrete pads and features still remain in the vicinity. The building has been used for storage or has been vacant since missile testing ended at Able 51 in the early 1970s. Currently abandoned, this unique building remains essentially as it was constructed, utilitarian in design with no decorative embellishments. The isolated setting and distinctive design contribute to its integrity of feeling. Building 1442 retains integrity of association as a missile launching facility (Facility Assessment Form/1442).

Communications/Instrumentation: Buildings 900, 1113, 1133, 1249, and 1284

With the advent of guided missile field testing at HAFB, new and unusual problems were presented to military personnel. In many cases, the actual testing of new missiles was comparatively easy compared to securing data regarding the flight test of vehicles. With unmanned test vehicles, large quantities of information had to be accurately and remotely obtained, such as the trajectory of a missile after launch, altitudes attained, velocities and accelerations, and rocket motor burning time. The problem revolved around choosing the most essential of the desired data which could be obtained with the instrumentation available. Instrumentation is defined as the large quantities of highly accurate optical and electronic devices used to obtain any information about the flight performance of a missile (HAFB 1950:32).

In 1948, the most pressing problem at HAFB was the haphazard instrumentation available for guidance, control, and test documentation. The Air Force delegated instrumentation responsibilities directly to Boeing and North American Aviation for the first test launches of Gapa and Nativ in 1948. North American Aviation installed six Askania phototheodolites, an instrument with both still and survey capabilities, at sites on the base for the Nativ program, and these were also used for other programs. The Askania was the world’s finest phototheodolite by the end of WW II, and the U.S. had obtained a number of the instruments after the war. By 1949, Land-Air Division was contracted to maintain instrumentation on the base, and because of the urgent need for standardization, Dr. Steinhoff from WSPG was brought in to assess the needs of range instrumentation (Weitze 1997:32-35).

Land-Air Division became responsible for providing data, using one of the ". . . most sophisticated data collection systems in existence" (Land-Air Division 1979:4). Instrumentation facilities listed as of 30 September 1950 included nine Askania cinetheodolites (designated Peter), three servo-tracked cameras consisting of modified B-29 turrets mounted with Mitchell high speed cameras (Mike or Yoke), three Clark New Products Ribbon Frame cameras with permanent mounting piers (Item), four SCR-584 S-band radar sets (Sugar), four SCR-584 X-band radar sets (X-Ray), four radar plotting boards (connected to X-Ray, Sugar, and Baker facilities), four M-2 Optical Trackers (connected with Sugar and X-Ray facilities), one AN/TPS-5 Doppler Radar set (Zebra-1), one stationary four-band FM-FM telemetering receiving station (Jig-1), one stationary pulse-time telemetering receiving station (Jig-2), one time standard system (transmitting from Queen-1), and one communications system comprising a command network (Figure 86, see Table 8). A typical array of instruments used for a test program is illustrated for an Aerobee ground-to-air research project which used "five Askania cinetheodolites, two servo-tracked cameras, two Clark New Products Frame cameras, two SCR-584 X-band radars with plotting boards and boresights and data box cameras, one time standard system, [and] two communications networks" (Best 1948; Land-Air Division 1950). An instrumentation array for the Nativ launch complex is shown in Figure 87.

Meeter (1967:8) states of the jointly used 40 x 100 mile HAFB/WSPG range:

> The corridor is also the most highly instrumented piece of real estate . . . in the United States. From one end to the other its Army-administered equipment and facilities include over 1,100 active instrumentation sites. . . . On and around the range a complex of high precision instruments, both optical and electronic, gather data from every test. An integrated trajectory system, long-range cameras, powerful telescopes, telemetry stations, the most advanced radar equipment . . . all . . . form part of the great tracking network.

The most notable of the instrumentation facilities was the "Air Force type two story cinetheodolite buildings" (Dynalectron Corporation 1964), including Buildings 900, 1133, and 1249 on HAFB. The original phototheodolite sites were ground facilities consisting of, in the best case, a concrete pad supporting a metal instrument stand and utility building (see Figure 7). One of Dr. Steinhoff's recommendations during his 1949 base assessment was that the phototheodolites be placed in towers at least 30 ft above the ground to eliminate the effects of intense heat at ground level and be sited on local topographic high points. In a 1951 addition to these recommendations were drawings of the proposed elevated cinetheodolite towers, which were two story, flat roofed structures without shelter for the Askania. Although the first of the towers was built closely following the 1951 drawings, by mid-1953 and into 1954, towers were built with a retractable, pyramid-like roof (Figure 88). The final towers followed Dr. Steinhoff's 1949 recommendations being both elevated and sheltered (Weitze 1997:22, 60-61).

The Askania cinetheodolite consisted of a photographic objective lens and a pulse operated camera mechanism supported on a yoke and base structure (Figure 89). The line of sight of the objective lens could be rotated through 360 degrees in azimuth and slightly more than 180 degrees in elevation. The cinetheodolite operated on the same principal as a standard camera with a long range telescopic lens. It was a motion picture camera with a synchronized shutter mechanism and a theodolite for recording

Figure 86. “Present arrangement of the optical and electronic instrumentation at HAFB”, ca. 1949

Figure 86. "Present arrangement of the optical and electronic instrumentation at HAFB", ca. 1949 (adapted from Holloman Air Development Center 1949:7).

Figure 87. Typical arrangement of instrumentation at HAFB: range requirements for the Nativ program, ca. 1947

Figure 87. Typical arrangement of instrumentation at HAFB: range requirements for the Nativ program, ca. 1947 (Ramo 1948).

Figure 88. A Missile theodolite tower: the Mart site (Building 900) looking south, 26 November 1963

Figure 88. A Missile theodolite tower: the Mart site (Building 900) looking south, 26 November 1963 (courtesy of Marshall Hunter, WSMR History Museum, E. J. Franczak collection).

azimuth and elevation. A series of target poles located in a circular array at each 45 degree azimuth around a facility was used to calibrate the instruments prior to their use. The primary purpose of the Askania was to provide position and/or trajectory information on test objects such as rockets, drones, air-to-air missiles, ground-to-air missiles, and aircraft. When multiple stations were used to track a test vehicle, they were all linked together by a common timing signal to ensure accuracy (Mattson and Tagg 1995:73-77). A 1950 HAFB Guided Missiles Requirements report states:

> The Askania Cinetheodolites are located in various positions on the range in order to give the best triangulation for any particular missile flight. For

minimum accuracy in the determination of a missile trajectory through space, it is desirable to have a minimum of three cinetheodolites properly located, although as many as six or seven are frequently employed for one flight to provide cross checking for accurate results. A total of some seventeen Askania sites are now situated on the USAF range with a minimum of seven additional uprange sites necessary to successfully implement the accelerated missile programs (HAFB 1950:35).

Figure 89. Askania cinetheodolite camera at a fixed camera ground station on HAFB, ca. 1948

Figure 89. Askania cinetheodolite camera at a fixed camera ground station on HAFB, ca. 1948 (HAFB Environmental Flight, Cultural Resources Photo Archives).

The HAFB missile theodolite towers represent three of a series of eight Askania sites on HAFB and WSMR; there are five identically constructed towers on what is now WSMR (Kammer 1996:2). In the following descriptions, only that for Building 900 is complete with details, because all towers are constructed the same. The descriptions for Buildings 1133 and 1249 include only individual characteristics of those facilities. The facilities are described as Air Force-type, three story cinetheodolite buildings with an eight target pole array around them (although the buildings are actually two story with the instrument set on the flat roof). The three buildings are on archaeological sites with associated features (see Table 3). The Mart site (Building 900) and Pritch site (Building 1133) are in relatively good condition. Pritch still retains all intact associated features including a generator shelter, outhouse, and the facility name spelled

out in stone. The Mart site, which had power poles running to it and therefore did not have a generator, still has its facility name but the outhouse is no longer standing. The Sole site (Building 1249) does not retain any of its original outbuildings and numerous features were built on the site at a later time. It also has been heavily vandalized. None of the buildings on the three sites remain in use for their original functions (Mattson and Tagg 1995:78-89).

The three missile theodolite buildings, located in the Supplemental Area, were constructed to house phototheodolite equipment. Two of the sites, Pritch and Sole, were constructed on sites where ground stations existed previously. Peter 8 once existed at the Sole site, and an historic HAFB map shows a ground station at Pritch that was probably Peter 6. Historic records call the stations "low-speed cinetheodolite," although each facility also had a George designation (Pritch=George 56, Sole=George 58, and Mart=George 47) (Dynalectron Corporation 1964; HAFB CRM site files/HAR-005 [Sole site]). Weitze (1997:60) indicates that the George designator was for ballistic cameras.

The final Communications/Instrumentation facilities are Buildings 1113 and 1284. Building 1113 (Queen-2) was one of the communications distribution facilities located in the HAFB Supplemental Area that served all of WSMR and HAFB (Department of the Air Force 1986:14). All timing and communications functions for guided missile activities on the integrated range took place in and around King-1 (Building 1102), just south of the MTSA. The King-1 facility provided mission control data processing and data display capabilities critical to test range operations (Lewis and Staley 1994:31). Communication was a critical part of missile testing, ensuring that all aspects of a test worked in tandem. A series of communications centers, the Queen facilities, was situated throughout the Supplemental Area. In 1951, there were four Queen facilities: Queen-1 was Central Control, Queen-2 (Building 1113) was an Amplifier House and the local timing distribution center, Queen-3 was a Pole Line Junction used as the downrange timing distribution center, and Queen-4 was the Control for the NIP (meaning unknown) area (HAFB 1951:67).

Building 1284 (Jig-1), the Tularosa Peak Missile Instrumentation Building, provided missile test telemetry data and communications support (Lewis and Staley 1994:30). For the HAFB programs, "[o]ne of the most important methods of obtaining data about a missile in flight is by means of radio telemetering equipment . . ." (HAFB 1950:34-35). Because of the very flat topography of the HAFB test range, optical and electronic instruments were located on all of the prominent peaks, such as Tularosa Peak. Building 1284 contained telemetering equipment such as recording cameras and oscilloscopes. The cameras photographed oscilloscope traces, and the oscillographs recorded, on moving sensitized paper, light traces from mirrors mounted on sensitive galvano meters. Fifty-eight separate telemetering channels were available: four continuous channels and the rest commutated channels. In addition, radar vans could park beside the building with other types of recording instrumentation (HAFB 1950: xvii, 34-35).

The five communication/instrumentation buildings are not described in numerical order. Buildings 900, 1133, and 1249 are described first because of their identical construction and function, followed by Buildings 1113 and 1284.

Building 900

Building 900, just north of the northern-most runway (Runway 04-22), was completed in 1954 as a missile theodolite station (see Figure 12 and Appendix C). The facility is also known as Mart site, George 47, perhaps Peter 19, and Army Building 29600. It is a two story, permanent, monolithic concrete facility exhibiting a square footprint (see Figure 88). The building was constructed completely of reinforced concrete: the foundation consisted of continuous wall footings, the walls were 10" thick poured concrete, and the flat roof was an 8" thick reinforced concrete slab supported by two concrete cross beams. The hatch to the upper level is cut through this slab. The building is listed as being 17'8" square with 584 SF of interior space; the second story is listed as 272 SF. The original function of the missile theodolite tower was crossed out on the real property form and replaced with NAV (navigational) Tower. The only listed interim function is Missile Theodolite Station (ca. 1980), although according to a letter in the real property file it may have been used for storage (ca. 1984). It is currently managed by WSMR and is still listed as a Missile Theodolite Station (Real Property File/900; Facility Assessment Form/900).

No construction drawings specific to Building 900 were located, but a set of generic 1955 plans for the missile theodolite towers labeled as Building 1249 were located. A floor plan was also illustrated in a Dynalectron Facilities notebook (Dynalectron Corporation 1964) (Figure 90). These drawings show unpartitioned first and second floor rooms, a door on one elevation, two windows each on two elevations, and an interior stairway. Plan drawings illustrate two evaporative coolers flanking the door. Notable interior features would have been a Sterling Electric Company motor, DeLaval Steam Turbine Company rotary pump, and Wright Speedway hoist. The hydraulic plunger is still intact. Kenneth S. Clark (Santa Fe, New Mexico) provided the architectural drawings. The

Paramount Steel Corporation (Long Beach, California) roof was designed by the C.H. Leavell Company. The builder is unknown (CE File/1249-1; Facility Assessment Form/900).

Figure 90. Building 900 (Mart site), plan view of “three story Askania building”, ca. 1964

Figure 90. Building 900 (Mart site), plan view of "three story Askania building", ca. 1964 (Dynalectron Corporation 1964).

For Building 900, access is gained through a single-hung metal personnel door at the principal (east) elevation. Four awning windows, two at the first floor and two at the second floor, are symmetrically placed at the north and west elevations and one window is offset above the door on the east elevation. Each window is set in a stepped rectangular opening. The first and second stories are 16'8" high. A flat, reinforced concrete slab provides a floor for the top, or third, story (see Figure 90). An 11'6" square, 3'11" high plywood wall enclosure and an instrument stand are situated on this floor, which are covered by retractable, peaked, four segment aluminum panels (Figure 91). When in use, these panels were operated with a hydraulic system using a concrete counterweight connected to a steel I-beam with a steel cable. The panels slid down the exterior framework and exposed the top story, in the center of which an Askania cinetheodolite camera was mounted on an instrument stand. The tower has a concrete interior stairway to the second floor. A metal ladder accesses the top story through a small hatch in the 8" thick reinforced concrete ceiling (Facility Assessment Form/900; Mattson and Tagg 1995:80).

Building 900 still has its two story scope, square footprint, and retractable aluminum roof, and retains its historic integrity. Essential design elements remain intact and no structural modifications were noted. The building represents a unique architectural structure built to house instruments and is the finest example of a two story, monolithic concrete, cinetheodolite shelter on HAFB. The building is located north of the Main Base in a remote area with nearby support facilities. Most of these contemporary features, such as the propane tank stand, facility name spelled out in stone, and the eight calibration target pole array, are intact (Figure 92). The outhouse and propane tank are gone and the air evaporative coolers, electric hoist, hydraulic lift, butane tank, and air coolers have been removed. It is unknown if interior features remain intact because entrance was not gained to the facility. Building 900 appears to have been continually used either for its stated purpose or storage since its construction in 1954. Nearly all original elements are intact, and the building retains its feeling as a Missile Theodolite Station (Facility Assessment Form/900; Mattson and Tagg 1995:80).

Building 1133

Building 1133, located west of the HSTT, was completed in 1954 as a Missile Theodolite Station (see Figure 12 and Appendix C). The facility is also known as the Pritch site, George 56, P [Peter] 34, perhaps Peter 6, and Army Building 29562. It is constructed identically to Building 900 with the exception of the location of the windows: the four windows are set at the north and west elevations with one above the door at the east elevation (see Figure 90). The hydraulic plunger is still intact. Listed functions for the building include Lease #67 (unknown function and undated) and Missile Theodolite Station (ca. 1980). It is currently vacant (Facility Assessment Form/1133; Mattson and Tagg 1995:84; Real Property Accountable Record/1133).

Figure 91. Plan and profile of retractable, peaked, four segment aluminum roof for the Missile Theodolite towers

Figure 91. Plan and profile of retractable, peaked, four segment aluminum roof for the Missile Theodolite towers (CE File 1249-2, IE 1435).

Figure 92. Mart site map (HAR-018r/LA 107798) with Building 900 and associated features

Figure 92. Mart site map (HAR-018r/LA 107798) with Building 900 and associated features (adapted from Mattson and Tagg 1995:81).

Two intact structures, an outhouse and generator shed, are associated with Building 1133 (Figure 93). The outhouse is wood framed with lap siding, has a gable roof, and exhibits a five-panel wood door at the south elevation. Corners are covered at the exterior with metal. The roof is sheathed using 1" x 10" boards clad with roll roofing. The structure is 4'3" x 5'2" with an interior clear height of 7' from the finished wood floor to the top plate. A bench within the outhouse contains one commode hole and a weathered roll of toilet paper. The generator shed is constructed using 4" x 4" wood posts set on 12" square isolated concrete footings. Three sets of posts support double 2" x 8" beams which span the posts, slightly pitching down from north to south. The beams support 2" x 4" joists spaced 2' on center which support 1" x 10" sheathing boards. The sheathing is clad using roll roofing (Facility Assessment Form/1133; Mattson and Tagg 1995:84).

Figure 93. Pritch site looking northwest with Building 1133, temporary generator shelter, trash barrel, and outhouse, 26 November 1963

Figure 93. Pritch site looking northwest with Building 1133, temporary generator shelter, trash barrel, and outhouse, 26 November 1963 (HAFB Environmental Flight, Cultural Resources Photo Archives).

Building 1133 maintains its two story scope, square footprint, and retractable aluminum roof, and retains historic integrity. All original structural and architectural elements remain intact and there are no design embellishments. The building exhibits a highly distinctive element of design and workmanship and, with its associated features, is the most intact missile theodolite station on HAFB. The building is located west of the HSTT in the Supplemental Area with nearby support facilities (see Figure 12). All of these contemporary features, such as the propane tank, facility name spelled out in stone, outhouse, generator shelter, 55 gallon trash barrel, fuel barrels for the generator, and seven of the eight calibration target pole array, are intact (Figure 94). The air evaporative coolers and water tanks once fronting the shelter were removed between 1964 and 1968 and the generator is missing. All interior features and equipment are

Figure 94. Pritch site map (HAR-007/LA 99633) with Building 1133 and associated features

Figure 94. Pritch site map (HAR-007/LA 99633) with Building 1133 and associated features (adapted from Mattson and Tagg 1995:85).

gone, the windows are broken or cracked, and the door glass is cracked. Building 1133 appears to have been continually used for either its stated purpose or has been vacant since its construction in 1954. The building remains essentially as it was built and, although no longer used as a theodolite shelter, retains a visible link with its design and setting as a missile tracking station (Facility Assessment Form/1133; Mattson and Tagg 1995:84).

Building 1249

Building 1249, located in the northeast corner of the base, was completed in 1954 as a Missile Theodolite Station (see Figure 12 and Appendix C). The facility is also known as the Sole site, George 58, and perhaps Peter 8. It is constructed identically to Buildings 900 and 1133 with the exception of the four window locations: they are set at the north and west elevations with one above the door at the east elevation (Figures 95 and 96). Listed functions for the building include Lease #69 (unknown function and undated) and Missile Theodolite Station (ca. 1980). It is currently vacant (Facility Assessment Form/1249; Real Property Accountable Record/1249).

Figure 95. Sole site looking south with Building 1249 and associated features, 26 November 1963

Figure 95. Sole site looking south with Building 1249 and associated features, 26 November 1963 (HAFB Environmental Flight, Cultural Resources Photo Archives).

Building 1249 maintains its two story scope, square footprint, and retractable aluminum roof and retains historic integrity. Although vandalized and missing associated features, the building shows no structural modifications and nearly all original materials remain visible. The building exhibits a highly distinctive element of design and workmanship, but is the most deteriorated example of a Missile Theodolite Station on HAFB. The building, with support features, was located in the northeast corner of the base

Figure 96. Building 1249, plan view of a Missile Theodolite Station, ca. 1955

Figure 96. Building 1249, plan view of a Missile Theodolite Station, ca. 1955.

Supplemental Area (see Figure 12). All of the contemporary features, such as the propane tank, facility name spelled out in stone, outhouse, and generator shelter have been removed or had more recent features constructed over them (Figure 97). Only the generator pad, propane tank supports, and four of the eight calibration target poles are intact. The air evaporative coolers and water tanks once fronting the shelter have been removed. There are bullet holes in the aluminum roof segments, front door, and on the interior stairwell and walls. Spray paint and pencil graffiti cover the interior and exterior of the building and associated features. The tower has been used for military maneuvers and spent blank cartridges and pyrotechnic devices litter the area. The door has been strengthened with iron braces and all windows have been blocked with concrete to keep out intruders. All interior features and equipment are also gone (Facility Assessment Form/1249; Mattson and Tagg 1995:87-89).

Building 1249 appears to have been continually used either for its stated purpose or for military maneuvers since its construction in 1954. Numerous concrete walls and features around the building imply modifications for activities that may not be listed on the real property record. Even with the vandalism and loss of associated features the building remains essentially as it was built and, although no longer used as a theodolite shelter, retains a visible link with its design and setting as a missile tracking station (Facility Assessment Form/1249).

Building 1113

Building 1113, located in the MTSA, was completed ca. 1949 as a Radio Relay Facility (see Figure 12 and Appendix C). It is described as a “Timing-Communications Distribution Station” with the military designation of Queen-2, and was Army Building 29650 (Dynalectron Corporation 1964). Building 1113 is a permanent, one story, two room structure showing a rectangular footprint with an offset stairwell and a low gable roof (Figure 98). The building was constructed completely of poured and reinforced concrete. It is listed as being 16' x 28' with an offset of 5' x 10'. It contained 448 SF of interior space, with an addition of 50 SF (through 1957) bringing the total to 498 SF.

The only listed interim function for the building was Lease #69 (function and date unknown) and it is currently used for storage by Dynalectron Corporation (Facility Assessment Form/1113; Mr. Sandoval, Dynalectron Corporation, personal communication 1997; Real Property Accountable Record/1113).

Figure 97. Sole site map (HAR-005/99457) with Building 1249 and associated features

Figure 97. Sole site map (HAR-005/99457) with Building 1249 and associated features (adapted from Mattson and Tagg 1995:88).

Figure 98. Building 1113 as a Dynalectron Corporation storage facility in 1996, northeast and southeast elevations

Figure 98. Building 1113 as a Dynalectron Corporation storage facility in 1996, northeast and southeast elevations.

No drawings were located for the building so one was drawn for the current project. It shows an 18' x 39'11" two room building with an 8'3" x 9'10" offset stairwell (Figure 99). The facility is unique in that it is semisubterranean with one half story subsurface and one half story above grade. The building consists of a main equipment room (12'10" x 30'1") and a small mechanical room (9'10" x 11') at the northwest corner, each accessed by a set of exterior hollow core double doors faced with plywood. Nine below grade concrete steps surrounded by retaining walls descend to a landing and provide access to these doors. A manhole accesses a 5'2" x 9'8" conduit vault at the southwest elevation of the building and an at grade metal louver and attached junction box are at the southeast elevation of the main room. Two windows, one at each room, are at the northwest elevation. The interior of the main room has 12" square acoustic ceiling tiles and 8" square floor tiles. The mechanical room interior has been plastered. No interior partitioning is noted within the rooms. Two sinks are attached at the interior north wall. A notable interior feature is an oil burner installed in the mechanical room. It bears an installation sticker date of “9-15-49 Artesia, NM.” The architect and builder of the facility are not known (Facility Assessment Form/1113).

Figure 99. Building 1113, floor plan of a Timing-Communications Distribution Station, 1996

Figure 99. Building 1113, floor plan of a Timing-Communications Distribution Station, 1996.

Building 1113 maintains its semisubterranean, one story scope, rectangular footprint, and low gable roof and retains historic integrity. The building appears to be relatively unmodified. All architectural features, including ceiling and floor tiles, windows, and doors appear to be either original or early improvements. The interior walls of the main equipment room have been painted and, with the exception of the oil burner, all interior equipment is gone. The equipment room window has been removed and the opening covered with plywood. The absence of drawings make it difficult to determine what, if any, modifications have been made to the facility (Facility Assessment Form/1113).

The building is located north of the Main Base in an area identified as a launching area on a 1957 base map and locally known as the MTSA (see Figure 12). Contemporary facilities and features such as Buildings 1116, 1139, 1142 and the JB-2 Ramp, as well as numerous concrete pads, still remain in the vicinity. The building has been used for its original purpose since its construction in 1949 and continues to exhibit its historic character as a radio relay building, thus retaining its integrity of association with early Cold War missile testing.

Building 1284

Building 1284, located on top of Tularosa Peak at the north end of the base, was completed in 1948 as a Missile Instrumentation Station (see Figure 12 and Appendix C). The facility may have originally been Building 1185 (Army Building 29256). It is described as a "Primary Ground Telemetry Recording Station" with the military designation of Jig-1 (Dynalectron Corporation 1964) (Figure 100). It is a one story permanent facility with a flat roof and rectangular footprint (54' x 100'). The building was constructed of concrete columns and spandrel beams with CMU infill. The foundation and floor are of concrete and the facility exhibits asphalt roll roofing on a concrete slab (the real property records indicate it was built-up block). Building dimensions on the real property form have been crossed out with others added. The new numbers are included here with the crossed out original numbers in parentheses. The building is listed as being 28'2" x 44'2" (29' x 48') with four offsets and two additions. The offsets are 6'4" x 5'5"

(6' x 33'), 7'4" x 28'7" (6' x 11'), 5' x 9'4" (6' x 9'), and 5' x 11'4". The additions include 12' x 20' metal (crossed out), 25'3" x 54'7" (first addition by USAF), and 40' x 54'7" (second addition by Army). It originally contained 1,710 SF of interior space (although a handwritten note in the file says 1,771 SF) with an addition of 1,618 SF through 1957. The final total with the USAF and Army additions was 5,332 SF. Listed functions include Lease #67 (function and date unknown) and Missile Instrumentation Station (ca. 1980). Letters in the real property file indicate it was used by NASA until ca. 1981 and by the 6585th Test Group, Test Track Support, from ca. 1982 to the present (Facility Assessment Form/1284; Real Property File/1284). It is currently abandoned, although instrumentation trucks are still parked on Tularosa Peak for use in various types of testing.

Figure 100. Building 1284, aerial view (looking east) of the Missile Instrumentation Station, with Building 1285 in the upper left, "MD-5 Tula Peak 10-8-63"

Figure 100. Building 1284, aerial view (looking east) of the Missile Instrumentation Station, with Building 1285 in the upper left, "MD-5 Tula Peak 10-8-63" (courtesy of Marshall Hunter, WSMR History Museum, E. J. Franczak collection).

The earliest drawing (1960) shows a 54'72" x 60' building with a 6' square offset at the northeast corner (Figure 101). The floor plan consists of three large rooms with smaller rooms and halls at the northwest and southeast corners. Single-hung doors access all rooms. Exterior openings include a set of double-hung doors and a single-hung door at the east elevation, a single-hung door and window at the south elevation, a set of double-hung doors and a window at the west elevation, and a single-hung door and window at the north elevation. A small rectangular offset is at the northeast corner and a dome for instrumentation has been constructed on the roof. The dome, which looks like the type seen at solar observatories, is positioned over a brass cap set into the floor of the building. The brass cap can be seen from a hole in the roof and is used as a datum for setting up and calibrating survey instruments (base datum). A series of steel steps access the roof at the east elevation and the roof is bounded by a metal handrail. The interior floor plan is divided into three main areas with smaller rooms at the north and south ends. The large open room closest

Figure 101. Building 1284, floor plan of the Missile Instrumentation Station, ca. 1960

Figure 101. Building 1284, floor plan of the Missile Instrumentation Station, ca. 1960.

to the south elevation and half of the central space show raised computer flooring. Notable interior features would have been telemetry receivers, FM/FM ground stations, recording systems, and oscilloscopes. No original drawings were located and neither the architect nor builder is known (Facility Assessment Form/1284).

Building 1284 maintains its one story scope, flat roof, and rectangular footprint and retains historic integrity. There were several additions constructed and many improvements and alterations during the building's period of historic significance, although all original construction materials and techniques have been retained. The 40' x 54'7" addition to the south elevation has obscured the original elevation and added three doors and two windows: a single-hung and set of double-hung doors at the east elevation, a window at the south elevation, and a set of double-hung doors at the west elevation. The window at the north elevation has been covered. The original openings at the other elevations remain in the same locations, although it is unclear whether the metal doors are original or replacements. Wooden stairs at the north elevation have been removed and computer flooring at the interior obscures the original tile floor (Facility Assessment Form/1284).

The building is located on top of Tularosa Peak and was once associated with other laboratories, storage sheds, and support buildings (Figure 102, see Figure 12). Many of these contemporary facilities no longer remain, with the exception of Building 1285 (described below). Although vacant and in a state of disrepair, the building could still function as it was originally designed and retains its integrity of feeling as a Missile Instrumentation Station (Facility Assessment Form/1284).

Storage/Support: Buildings 1127, 1285, and the Incinerator

The three storage and support facilities are associated with other Material Development facilities. Building 1127 was constructed in the MTSA as a Rocket Motor Conditioning Facility for the Falcon missile (MX-904). As discussed above, it is located within the Nativ launch complex near the end of the JB-2 launch ramp (see Figure 62). The building was probably part of the major modifications Hughes Aircraft completed on the JB-2 complex starting in the 1950-1951 period (Weitze 1997:53). It is currently used for storage. Building 1285 is located adjacent to Building 1284, the Tularosa Peak Missile Instrumentation Building described above (see Figure 102). It was apparently used for Research Equipment storage and is currently abandoned.

Figure 102. The Tularosa Peak Instrumentation complex showing buildings 1284 and 1285 and associated features, 9 August 1960

Figure 102. The Tularosa Peak Instrumentation complex showing buildings 1284 and 1285 and associated features, 9 August 1960
(Dynalectron Corporation 1964).

The Fuel Incinerator, located almost one mile east of the Aerobee launch complex, was also associated with the MTSA. In an interview with researchers from Radian Corporation, Mr. Marvin Weber, former Chief of Unconventional Fuels Program, said the incinerator was used from about 1955 to 1960 to dispose of (burn) unconventional fuels from the Aerobee sounding rocket made by Aerojet General. The rocket used a mixture of 65 percent furfuryl alcohol and 35 percent aniline, sometimes with a small amount of the reverse mixture. Xylidine was used occasionally as an experimental replacement for aniline. Mr. Weber indicated that fuel was transported to the launch site in drums or tank trailers. The tank trailers then transported waste fuel for disposal, utilizing a pump to transfer the fuel into the incinerator. The trucks parked north of the incinerator at a stainless steel fill line with an electrical ground. Fuel was pumped into the fuel line in much the same way an automobile gas tank is filled. The incinerator, now abandoned, is a hazardous waste site (Installation Restoration Program [IRP] Site LF-58) currently being remediated (Radian Corporation 1993:7.1–7.3; 49 CES/CEV IRP files).

Building 1127

Building 1127, located within the Nativ complex of the MTSA, was completed ca. 1955 as a Rocket Motor Conditioning Facility for the Falcon missile (see Figure 12 and Appendix C). It is a permanent, one story, rectangular facility consisting of two rooms with separate construction types (Figure 103). The building had concrete continuous wall footings and a concrete floor. The west room had painted, 12" thick reinforced concrete walls, while the east room had wood stud, wood sheathing, and asbestos shingles. The facility had asphalt roll roofing on a wood deck with wood rafters. The building is listed as being 20' x 43' (west room) with a 13'6" x 42' offset (east room) and having 1,427 SF of interior space. Listed functions for the building include Base Rocket Assembly Storage (ca. 1963); Security Police Storage (n.d.); and MWR/NAF Central Storage (ca. 1991). The building was returned to Real Property in 1994 and is currently in use by the 4th Space Warning Squadron for storage (Facility Assessment Form/1127; Real Property File/1127).

A 1954 drawing for Building 1127 shows two rooms with double doors and a ramada footing at the south elevation of the west room (Figure 104). The building measures 33'6" x 43'. The rooms are divided along the long axis by a 1' thick reinforced concrete wall, giving each room a 40' clear length: the west room is 18' wide and the east room 13'6" wide. The rooms are exclusively accessed by exterior doors fronted by concrete ramps; there are no interior doors. The west room has reinforced concrete walls and a gable roof. Due to its proximity to repeated missile firings, the room was constructed to be blast proof with structural and electrical systems built to specifications exceeding that required by normal loads. Poured reinforced concrete walls are thicker at the bottom, tapering upward toward the roof from a 12" wide base. Blast

Figure 103. Building 1127 as a MWR/NAF Central Storage facility in 1996, south and west elevations. Building 1116, the Nativ blockhouse, is to the east

Figure 103. Building 1127 as a MWR/NAF Central Storage facility in 1996, south and west elevations. Building 1116, the Nativ blockhouse, is to the east.

proof electrical fixtures are also noted on original construction drawings. Entrance is gained through double metal doors at the west elevation. The east room is constructed of wood stud walls and exhibits a shed roof. Entrance is gained through double-hung wood panel doors at the east elevation. There are no windows. Four concrete grade footings for a roofed ramada are attached to the south elevation. The ability to undertake rocket motor reconditioning required massive cooling capabilities. Large cooling units were situated under this ramada on 2" x 4" wood decking on 6" x 12" concrete grade beams supported by spread footings. A barbed wire fence surrounded the stand. An air cooler and stand were also located at the east elevation. Although original drawings were located, neither the architect nor the builder is known (Facility Assessment Form/1127; Mattson and Tagg 1995:33).

Building 1127 maintains its one story scope, rectangular footprint, and gable and shed roofs, and retains historic integrity. Essential design elements remain intact and no major structural modifications were noted. The cooling units, air cooler stands, 10' square deck, and shed roof on the south and east elevations are gone, as is the fence which surrounded the southern shed. One five-panel wood door has been replaced

Figure 104. Building 1127, the Rocket Motor Conditioning facility, floor plan, ca. 1954

Figure 104. Building 1127, the Rocket Motor Conditioning facility, floor plan, ca. 1954.

with plywood. The addition of a CMU wall in the west room obscures the original reinforced concrete (north) wall. All interior equipment has been removed. The building was located in the MTSA in the vicinity of the JB-2 launch ramp and Nativ blockhouse (Building 1116; see Figure 12). A site plan of the area also shows a generator pad and switch house (Building 1125; see Figure 62). All of these features remain intact. Building 1127 appears to have been continually used for storage after missile testing ended at the MTSA. The explosion proof structural and electrical design elements and missile launch setting contribute to this building's historic integrity of feeling (Facility Assessment Form/1127; Mattson and Tagg 1995:33).

Building 1285

Building 1285, located on top of Tularosa Peak beside Building 1284, was completed ca. 1950 for Research Equipment Storage (see Figure 12 and Appendix C). The one story, semipermanent building has a rectangular footprint and a gable roof (Figure 105). The building has a concrete foundation and floor and prefabricated walls and roof. It is listed as being 12' x 20' with 240 SF of interior space. There are no listed interim functions for the building, and it was not included on the real property inventory until some time after its construction. Notes from the Real Property file indicate the facility belonged to Dynalectron Corporation and NASA. It is listed as a supply shed (Army Building 29264) on the 1960 site plan and it is currently used for Research Equipment Storage (Facility Assessment Form/1285; Real Property File/1285).

No original drawings were located, and one was completed for the current project. The 12' x 20' building is accessed at the east elevation by a set of double metal doors (Figure 106). Three eight-light windows with painted panes are at the north elevation, and one is at the west elevation. A concrete pad is located at the northwest corner of the building. According to a manufacturer's plate at the exterior, the metal shed was prefabricated by the Parkersburg Rig and Reel Company (Parkersburg, West Virginia). The architect is unknown (Facility Assessment Form/1285).

Building 1285 maintains its one story scope, rectangular footprint, and gable roof. It retains its historic integrity and does not appear to have been modified since its original fabrication, although this could not be verified due to the lack of drawings. The building is utilitarian in design, materials, and workmanship with no decorative embellishments. It is located on Tularosa Peak and was associated with laboratories, storage sheds, and other support buildings (see Figure 102). Many of these contemporary facilities no longer remain, with the exception of Building 1284 (described above). This building, in association with Building 1284, maintains historic integrity of feeling and association with monitoring Cold War-era test launches (Facility Assessment Form/1285).

Figure 105. Building 1285, aerial view (looking south) of Tularosa Peak complex with Research Equipment Storage facility in the foreground and Building 1284 in the center, "MD-5 Tula Peak 10-8-63"

Figure 105. Building 1285, aerial view (looking south) of Tularosa Peak complex with Research Equipment Storage facility in the foreground and Building 1284 in the center, "MD-5 Tula Peak 10-8-63" (courtesy of Marshall Hunter, WSMR History Museum, E.J. Franczak collection).

The Incinerator

The Fuel Incinerator, located approximately 8/10 mile southeast of the MTSA, is thought to have been completed around 1950 because of its association with the Aerobee program (see Figure 12 and Appendix C). The structure does not have a facility number and no real property records or drawings were located. It is a small, rectangular, brick incinerator measuring 8' x 10', with a height of 5'9" from grade to the top brick course (Figure 107). A metal stack approximately 45' tall with an 18" diameter is situated at the west facade. A semicircular 7' diameter hood tops the brick structure. Long 5" x 10' metal plates are welded on edge along the circumference of the hood. Brick piers are three courses high and 9" on center. An electric "Mettler Entrained" combustion gas burner, set on masonry blocks, is located at the east elevation. An apparent opening at the east elevation has been bricked in. The architect and builder are not known (Facility Assessment Form/Incinerator).

Figure 106. Building 1285, floor plan of Research Equipment Storage facility in 1996

Figure 106. Building 1285, floor plan of Research Equipment Storage facility in 1996.

Figure 107. Incinerator, currently abandoned, in 1996. The water tower in the background is within the MTSA

Figure 107. Incinerator, currently abandoned, in 1996. The water tower in the background is within the MTSA.

Because no drawings were located, one was drawn for the current project (Figure 108). Without a Real Property Accountable Record, there is no documentation of the original, or later, function for the structure. As discussed above, archival research by Radian Incorporated (1993) indicates the structure was used to dispose of waste fuels associated with the Aerobee rocket between ca. 1955 and 1960. There is no evidence it was used for any other functions. The incinerator is currently abandoned.

The brick incinerator appears to be essentially intact and is thought to retain historic integrity, although no documentary evidence was located to verify this. The original opening on the east elevation has been bricked in. The brick, metal stack and hood, and combustible burner appear original and the structure most likely retains its original historic and aesthetic character. The structure is located southeast of the MTSA launching area which contains the Aerobee launch complex. Contemporary facilities and features in this complex, such as Building 1142 (Aerobee observation shelter) and numerous concrete pads and features, still remain today. The structure is also located near buildings once used for unconventional fuels storage and booster checks (Buildings 1193 and 1194). The structure continues to exhibit its historic character as an incinerator and retains integrity of association with early Cold War missile testing (Facility Assessment Form/Incinerator).

Figure 108. Incinerator, facility plan view and profile, 1996

Figure 108. Incinerator, facility plan view and profile, 1996.

CHAPTER 6

DISCUSSION

Martyn D. Tagg and Sonya Cooper

Thirty-four HAFB facilities were assessed for this project, including all those constructed in the 1940s (with the exception of housing units) and a select few early Cold War properties associated with missile testing in the 1950s and 1960s. The primary criteria used to determine the significance of the individual properties were their association with important events at a national and local level, physical integrity, and in some cases uniqueness. For that reason, this discussion focuses on the physical attributes and historic context of facilities, as well as construction styles and use/reuse patterns seen during the assessment process. The discussion leads into the NRHP eligibility recommendations for the WW II and early Cold War properties.

HISTORIC CONTEXT

The 34 facilities were constructed within four of the nine historic periods presented earlier (Table 9). Three sources were used to determine the original facility date: the Real Property Accountable Record, original construction drawings (as-built), and archival research. The Real Property Accountable Record lists a date of completion for 30 facilities. This was interpreted as the date the facility was ready for use, not when construction began, and was considered accurate except in three cases where construction drawings and archival research indicated earlier use. Original as-built construction drawings for Building 302 were dated 1942, although the Real Property date was 1943. In two cases, archival research indicated the Real Property completion date was after the end of the test program for which the facility had been constructed. Building 1116, the

Nativ observation shelter, was listed as completed in 1949 although the test program began and ended in 1948. Building 1139, the Gapa observation shelter, was listed as completed in 1951 although the program began at HAFB in 1947. Research by Weitze (1997) indicated both blockhouses were constructed in 1947. Finally, four structures did not have Real Property Accountable records; construction dates for the Incinerator, Test Stand, JB-2 Ramp, and Jeep Target were based on archival research.

Table 9
Holloman AFB Facility Time Line

1. *Outbreak: Augmentation of Facilities (1939-1940)*

2. *Disaster: Expansion of Facilities for Hemispheric Defense (1940-1941)*
   1941 Alamogordo designated for a bomber crew training facility, land acquisitions of 5,900 acres for base proper and 1,243,000 acres for range

3. *Intervention: Expansion of AAF Facilities (1942-1943)*
   1942 Construction began on AAAF in April
   - Building 302

4. *Victory in Sight and the Atomic Age: Consolidation and Disposition of Facilities (1943-1945)*
   1943 AAAF and ABGR fully operational as an OTU for Heavy bomber crews
   - Buildings 40*, 71*, 96, 107*, 200*, 205*, 218*, 289*, 291*, 300, 599*, 754, 1079, 1236*, 1237*, and Jeep Target

   1944 AAAF became a CCTS, B-24s are replaced with B-29 Very Heavy bombers
   - Building 301

5. *Inception of the Cold War (July 1945-January 1953)*
   1945 First Atomic Bomb exploded at Trinity site on ABGR in July, White Sands Proving Ground established
   1946 AAAF to be deactivated, then reactivated under SAC
   1947 AMC moves Wendover AAF guided missile program to AAAF (Gapa, JB-2, and Tarzon), Nativ testing begins. AAAF becomes the Alamogordo Guided Missile Test Base
   - Buildings 1116, 1139, and JB-2 Ramp

   1948 Installation officially named HAFB; Matador/Mace testing begins
   - Building 1284

   1949 Aerobee and Falcon testing initiated, Steinhoff's Range Instrumentation study
   - Buildings 322, 1113

   1950 HSTT completed and first sled run
   - Buildings 1142, 1285, and Incinerator

   1951 HAFB transferred from AMC to Air Research and Development Command, AFL organized
   1952 HAFB and WSPG ranges combined into the Integrated White Sands Range; HAFB became the Holloman Air Development Center

6. *Nuclear Technology Escalation (January 1953-November 1963)*
   1953 Steinhoff recommends two story, elevated, and sheltered cinetheodolite stations, WSPG assumes maintenance and operation responsibility for all integrated range instrumentation sites
   1954 Lt. Col. John Stapp becomes first human rocket sled test subject on HSTT
   - Buildings 900, 1133, and 1249

   1955 HAFB chosen as missile development center for ICBM, and new launch facility construction began
   - Building 1127 and Test Stand

1956 ICBM test and training base decision overturned and program went to Vandenberg AFB
1957 HADC redesignated Air Force Missile Development Center
1959 Manned F-100 Super Sabre launched from ZEL launcher at Able 51
___ Building 1442
1962 ___ Building 1440

7. *Détente (November 1963-January 1981)*

8. *A New Deterrence (January 1981-November 1989)*

9. *Transition into the Future (November 1989-present)*

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* probably under construction in late 1942

World War II (18 facilities)

Plans for establishing AAAF were initiated in 1941 during a major expansion of airfields throughout the U.S. in response to American intervention in WW II. Initial construction of the base did not begin until April 1942. By June, the base was officially operational for its bomber crew training mission which continued until the end of the war in 1945. Eighteen WW II facilities were present on HAFB, representing the final two historic periods of WW II with construction completion dates of 1942 (n=1), 1943 (n=16), and 1944 (n=1).

Intervention: Expansion of USAAF Facilities (1942–1943)

Only one building was completed by 1942 (see Table 9). Building 302 may represent the oldest building on the base. Unfortunately, the completion dates shown on the table may be misleading. Eleven additional buildings are thought to have been built as part of the original base construction. Comparison of a 28 December 1942 aerial photograph of the base Cantonment Area with the 1943 Post Map indicates these buildings, listed as completed in 1943, were in place at the earlier time (see Figure 10). This suggests that Buildings 40, 71, 107, 200, 205, 218, 289 (286), 291, 599, 1236 (1206), and 1237 (1208) were at least in the construction stage by late 1942. For this reason they are discussed in the 1942/1943 historic period.

This time period represents the beginning of the U.S. air offensive in Europe, which was based on precision daylight bombing using B-17 and B-24 Heavy bombers. In late 1941 and early 1942, the USAAF began finding and developing new airfields to facilitate the expansion of combat groups. As part of this expansion the Second Air Force, responsible for Heavy bomber crew training, acquired AAAF as one of its new training bases. The base served as an OTU for training B-17 and B-24 Heavy bomber flight crews for combat in Europe until 1944. Most facilities were put into use before they were completed and new construction was mainly of the temporary TO wooden type because the need for these bases was immediate. AAAF was no exception. As discussed above, construction began in April 1942 and the base was ready for use in June, a period of only two months. It can only be assumed that many of the buildings were still under construction when the base began its mission, which might explain the 11 buildings with 1943 completion dates on the 1942 aerial photograph.

The 12 oldest buildings on HAFB (from late 1942) are within the Main Base portion of the Cantonment Area, which included operational and administrative and housing areas. The buildings represent the wide range of support functions necessary for the base's aircrew training mission. This includes the administration (n=2: Buildings 200 and 205), housing (n=1: Building 218), and training (n=3: Buildings 40, 107, and 599) of aircrews; base and aircraft maintenance/support (n=3: Buildings 71, 291, and 302); and storage of munitions and hazardous material (n=3: Buildings 289, 1236, and 1237). The buildings are also very representative of early WW II bare bones and boilerplate construction with similar or identical buildings being constructed on bases throughout the U.S. Only two buildings were of a permanent construction type (Buildings 302 and 1237). The remainder were either temporary (n=3) or semipermanent (n=7). Nine of the buildings had wood frame construction. The three storage buildings for munitions and hazardous materials were constructed of hollow clay tile.

Victory in Sight and the Atomic Age: Consolidation and Disposition of Facilities (1943–1945)

The remaining six WW II facilities (Buildings 96, 300, 301, 754, 1079, and Jeep Target) were completed in 1943 and 1944 during a time when the U.S. role in the war heightened (see Table 9). Strategic daylight precision bombing became standard operating procedure in Europe, bringing about a continuous need for replacement crews for Heavy bombers. In addition, the U.S. was on the offensive in the Pacific campaign against the Japanese. AAAF continued to grow in its role as an OTU until March 1944 when it became a Combat Crew Training Station. That month the first B-29 Very Heavy bombers began to arrive at the base. The mission focus changed to training replacement crews to man these bombers for duty against the Japanese.

The six 1943 and 1944 buildings represent the continued growth of the base as a training facility and are similar in function and construction to those built during the earlier period. Buildings 96, 300, and 301 are located within the Main Base, while Building 1079 is in the operational North Area. Building 754 was undoubtedly once in the Main Base, but was apparently moved to the golf course at a later time. All of the buildings are of common WW II boilerplate design. There are three aircraft maintenance hangars (Buildings 300, 301, and 1079); two storage buildings (Buildings 96 and 754); and the Jeep Target training facility. Of the five buildings, three are of permanent construction, one is semipermanent, and one is temporary. Four of the buildings are TO wood frame types, while the Building 300 hangar has a metal frame and corrugated metal siding. The Jeep Target, used for training gunners, was an earthen berm with a concrete track.

Cold War (16 facilities)

As WW II came to a close, many changes occurred at AAAF. The bombing range gained national attention with the explosion of the first atomic bomb at the Trinity site in July 1945. The training mission wound down at AAAF and the base became a processing facility for soldiers returning from overseas. The bombers and most personnel left the base and, by 1946, AAAF was one of many facilities across the country being deactivated. The beginning of the Cold War, and the resultant arms race, brought new life and a new era of use to AAAF as the U.S. missile testing and development program came to southern New Mexico. The 16 Cold War facilities investigated during this project represent this period of transition and fall within the first two historic periods of the Cold War. Nine facilities were completed between 1947 and 1953 (Buildings 322, 1113, 1116, 1139, 1142, 1284, 1285, JB-2 Ramp, and Incinerator) and seven between 1953 and 1963 (Buildings 900, 1127, 1133, 1249, 1440, 1442, and Test Stand).

Inception of the Cold War (July 1945-January 1953)

The U.S. dropped two atomic bombs on Japanese cities in August 1945, bringing WW II to an end. Almost immediately the political balance of world power changed and there was a rapid reversal in the political relationship between the U.S. and the U.S.S.R. The resultant Cold War began with the rapid development of long range missiles to ensure the U.S. had a first or retaliatory strike capability. The U.S.-U.S.S.R. arms race resulted in the construction of new facilities on existing bases and slowed the rapid draw down of forces that began directly at the end of WW II. The USAAF had been developing and testing missile technology toward the end of WW II at Wendover AAF in Utah and Eglin AAF in Florida. In 1947, Air Materiel Command consolidated its research and development programs at AAAF in southern New Mexico because of the ideal environment and isolated nature of the base. By the end of that year, pilotless aircraft, guided missiles, and associated instrumentation systems and equipment were being developed and tested at AAAF, now the new SAC facility, in conjunction with work at the Army's adjacent WSPG. These early studies were predominantly research and development for the weapons systems characteristic of the earliest USAF programs designed to stay ahead of the U.S.S.R. in the arms race. German scientists, brought to the U.S. after WW II, led the way in this new weapons research. By 1947, the U.S. Army Air Forces became a separate service, the U.S. Air Force, and Alamogordo Army Air Field became Holloman Air Force Base.

The nine facilities constructed on AAAF/HAFB during this early Cold War period, between 1947 and 1950, are representative of changes in both the base layout and construction styles. Small testing and development complexes began to spring up on the undeveloped Supplemental Area north of the Cantonment Area. This was probably in response to the large safety zones required for missile launching and testing, the locational needs for the large variety of communications and instrumentation facilities necessary for documenting the missile testing, and for security. The Cantonment Area also grew to support the personnel required to conduct the research but retained its three part layout. By the end of this historic period, two missile testing complexes were operating in the Supplemental Area: the MTSA and the HSTT. In addition, isolated instrumentation facilities were scattered from just north of the Cantonment Area to 100 miles north on WSPG. Construction types changed from that of WW II temporary structures to functionally distinct, permanent styles. Concrete masonry unit buildings replaced wooden construction and poured concrete blast proof buildings were constructed to facilitate missile testing.

Six buildings and two structures represent HAFB's missile testing mission and the ninth is a support building. The eight missile facilities are located in the Supplemental Area: six (Buildings 1113, 1116, 1139, 1142, JB-2 Ramp, and Incinerator) are associated with the MTSA and Buildings 1284 and 1285 are part of the Tularosa Peak instrumentation/communications complex. The buildings include three observation shelters, two instrumentation/communication facilities, and one storage shed. The base support facility, Building 322, is the Swimmer's Bathhouse located in the Main Base. Six of the seven buildings are of permanent construction, with three methods of concrete construction used dependent on function. These methods are discussed in more detail below. The three observation shelters for missile testing (Buildings 1116, 1139, and 1142) are constructed of poured and reinforced blast proof concrete walls and roofs to protect observers and operators from the blast or impact forces of a missile launch; Building 1113 has poured concrete walls and roof and is semisubterranean, perhaps also because of its location near missile launch complexes; and Buildings 322 and 1284 have reinforced concrete frames with CMU infill, a construction style Fulton and Cooper (1996:407-410) found to be common for Cold War buildings. Building 1284 has concrete columns and spandrel beams and represents an early Cold War experimental atomic bomb proof design. Building 1285 is a semipermanent prefabricated metal shed. The two structures, the JB-2 Ramp and Incinerator, are constructed of earth and brick, respectively. It is unknown if they were permanent or temporary facilities.

Nuclear Technology Escalation (January 1953-November 1963)

Subsequent to the early 1950s, U.S. military bases continued to expand and change as a result of new aircraft and weapons developments such as larger, heavier bombers (the B-52) and jet aircraft. The weapons of choice were air-launched missiles and ICBMs, the latter launched from hardened silos. Nuclear arms build-up continued to ensure the U.S.

held the advantage in case of a nuclear war. HAFB's missile development role changed with these national trends. Many of the base's original test programs had ended and focus was shifted to testing air-launched guided missiles and target drones and components testing on the HSTT. Great strides were made in the development and improvement of communications and instrumentation systems necessary to document the missile programs. German scientists continued to contribute heavily to the research. HAFB was chosen as the final location for mid-1950s ICBM testing and training, based on Eisenhower's dispersal or California policy and construction began on a number of new test complexes. Unfortunately, this decision was overturned and no ICBM testing was accomplished at the base. The arrival of a tactical fighter wing in 1963 was the beginning of the end for HAFB's use as a primary missile development center.

The final seven facilities investigated during this study, constructed between 1954 and 1962, represent examples of advanced instrumentation development, the change toward air-launched missile and target drone testing, and the proposed use of HAFB for ICBM testing. The seven facilities follow trends started in the earlier Cold War period. All of the facilities were constructed in the Supplemental Area in either existing or new complexes. Missile testing continued at the MTSA and the new Able 51/ZEL complex was constructed. The isolated, scattered instrumentation facilities continued to be used, with changes from ground stations to enclosed, two story buildings. Construction types also continued from the previous period with permanent, functionally distinct styles the norm.

Four of these facilities represent HAFB's missile testing mission and the other three are instrumentation buildings. Two facilities, a missile assembly building (Building 1127) and the Test Stand, are associated with the MTSA, and Buildings 1440 (observation shelter) and 1442 (launch facility) are part of the Able 51/ZEL launch complex. The three instrumentation buildings are the missile theodolite towers (Buildings 900, 1133, and 1249). The six buildings are of permanent construction and the Test Stand was probably built to be permanent but no records were located to support this. Five of the six buildings and the Test Stand were constructed of reinforced concrete; Building 1127 also has a wood frame room and the three instrumentation buildings have unique aluminum, retracting roofs. Building 1442 was constructed of a steel bent frame covered with corrugated metal and represents an early Cold War atomic bomb proof (hardsite) design.

PATTERNS OF FACILITY USE AND MODIFICATION

Patterns of facility use, reuse, and modification varied greatly among the facilities discussed here. The degree of reuse and modification for individual facilities, and thus their current physical integrity, appear to be the result of a combination of three factors: location, original and interim functions, and construction methods. In most cases these factors were dependent on one another. The original function of a facility dictated, in most cases, where and how it was constructed, which in turn determined the amount of reuse and modification. The three factors are briefly discussed, followed by their application to the 34 facilities. Table 10 summarizes the results.

1. Location. HAFB can be divided into four broad areas where facilities are located: the Cantonment Area (Main Base, West Area, North Area, and Golf Course), Munitions Storage Area, Jeep Target Training Area, and Supplemental Area (the vast expanse of unimproved land to the north of the improved areas). The Cantonment (with the exception of the Golf Course), Munitions Storage, and Jeep Target Training areas were constructed in 1942 and have been in continuous use for the purposes

Table 10
Facility Attributes

Bldg #	Date	Location[4]	Original Function	Construction Type[1]	Method	# Interim Functions[2]	Current Functions[3]	Physical Integrity
WW II:								
40	1943	Main Base	Classroom	S	Wood	4	Family Support	No
71	1943	Main Base	Storage	S	Wood	3	Office	No
96	1943	Main Base	Warehouse	T	Wood	0	Storage	No
107	1943	Main Base	Classroom	T	Wood	5	Vacant	No
200*	1943	Main Base	Office	S	Wood	2	(Vacant)	No
205	1943	Main Base	Office	S	Wood	3	Library	No
218	1943	Main Base	Dormitory	T	Wood	6	Thrift Shop	No
289	1943	Main Base	Storage	S	Clay Tile	0	Storage	Yes
291	1943	Main Base	Hangar	S	Wood	0	Hangar	No
300	1943	Main Base	Hangar	P	Corrugated metal	0	Hangar	No
301	1944	Main Base	Hangar	P	Wood	0	Hangar	Yes
302	1942	Main Base	Shop	P	Wood	5	Operations	No
599*	1943	Main Base	Firing Range	T	Wood	1	(Maintenance)	No
754*	1943	Golf Course	Storage	P	Wood	0	(Storage)	No
1079	1943	North Area	Hangar	S	Wood	0	Hangar	Yes
1236	1943	Munitions	Storage	S	Clay Tile	0	Storage	Yes
1237	1943	Munitions	Storage	P	Clay Tile	0	Storage	Yes
Jeep Target	1943	Training Area	Firing Range	?	Dirt	0	Training	Yes
Cold War:								
322	1949	Main Base	Bathhouse	P	CMU	0	Rec Center, Shower Facility	Yes
900	1954	Supplemental	Instrumentation	P	Reinforced Conc.	0	Navigational Aid	Yes
1113	1949	Supplemental	Communication	P	Poured Concrete	0	Vacant	Yes
1116	1947	Supplemental	Blockhouse	P	Reinforced Conc.	0	Vacant	Yes
1127	1955	Supplemental	Storage	P	Reinforced Conc., Wood	0	Storage	Yes
1133	1954	Supplemental	Instrumentation	P	Reinforced Conc.	0	Vacant	Yes
1139	1947	Supplemental	Blockhouse	P	Reinforced Conc.	1	Storage	Yes
1142	1949	Supplemental	Blockhouse	P	Reinforced Conc.	0	Storage	Yes
1249	1954	Supplemental	Instrumentation	P	Reinforced Conc.	0	Vacant	Yes
1284	1948	Supplemental	Instrumentation	P	CMU, concrete columns	0	Vacant	Yes
1285	1950	Supplemental	Storage	S	Steel	0	Storage	Yes
1440	1962	Supplemental	Blockhouse	P	Reinforced Conc.	1	Storage	Yes
1442	1959	Supplemental	Missile Launch	P	Steel Panel	0	Vacant	Yes
JB-2	1947	Supplemental	Missile Launch	?	Earth	0	Abandoned	Yes
Test Stand	1955	Supplemental	Missile Test	?	Poured Concrete	?	Abandoned	Yes
Incinerator	1950	Supplemental	Incinerator	?	Brick	?	Abandoned	Yes

Key:
* demolished
[1] T=Temporary, S=Semipermanent, P=Permanent
[2] different from original use and not including storage
[3] last use in parentheses if building demolished
[4] Cantonment Area includes Main Base, North Area, and Golf Course

for which they were established. Facilities within these continuous use areas have always supported the base mission, whatever that was at the time. Isolated launch complexes and instrument stations were scattered throughout the Supplemental Area, but with the exception of the HSTT, these small complexes or isolated facilities were constructed for specific programs, used for short periods for their original function, and then abandoned. Very few mission activities occur in the Supplemental Area at the present time. The location of a facility, then, became a major factor in whether or not it was convenient for continued use: facilities in the Cantonment, Munitions Storage, and Jeep Target Training areas would have a higher probability of reuse and modification than those in the Supplemental Area.

2. Function. All facilities were built for specific functions, and in most cases this function resulted in the type and method of construction and its location. For instance, a WW II aircraft maintenance hangar consisted of a large open bay capable of covering an aircraft. The building would be located near the runway for access by aircraft but could be constructed as temporary or semipermanent due to its expected short period of use. An administrative building could be a small facility with interior office partitions and would be located in the operational Cantonment Area for easy access by base personnel. A missile observation shelter would be of blast proof construction and located in a remote area for safety and security reasons. Function dictated how and where a facility was constructed, which, in turn, determined the potential for reuse and modification. Facilities with very specialized functions, such as hangars and observation blockhouses, were more likely to be used for those purposes at a later time, while generic type buildings, such as those used for administration and training, could easily be modified for different functions.

3. Construction. The type and method of construction (architectural style) depended on two primary factors: when the facility was built and its planned function. The military recognizes three types of construction based on the length of time the facility is expected to fill a need and the amount of maintenance needed to keep it functional: temporary, suitable for a short period of five years or less with minimal or no

maintenance; semipermanent, suitable for an extended period of more than five but less than 25 years with a moderate to high degree of maintenance; and permanent, suitable for more than 25 years with minimal maintenance. In WW II, most buildings were of the temporary or semipermanent type with the intent to fulfill the immediate needs of the war. They were constructed quickly (bare bones) using boilerplate plans and usually had a wood frame with tar paper or wooden siding and asphalt roll or slate shingle roofs. Specialty buildings, such as hangars or hazardous material and munitions buildings, were occasionally constructed of sturdier materials because of their function (i.e., munitions and hazardous material storage buildings were constructed of hollow clay tiles). During the Cold War, facilities were built more permanent with the intent for them to last for long periods and, in some cases, to withstand blast forces from missile testing or a possible atomic bomb blast. Construction methods for generic buildings changed from wood to CMU or poured concrete slabs. Specialty facilities such as observation blockhouses at missile complexes and instrumentation/communication buildings were constructed of reinforced concrete or concrete column and spandrel. The type and method of construction related directly to the amount of modifications necessary to keep a facility functional for, in some cases, 50 years. Temporary and semipermanent buildings would need extensive renovations and modifications to extend their life from five to 25 years. Original wood siding and asphalt or slate roofs would be replaced with more modern, longer lasting materials such as stucco, CMUs, or metal siding. Permanent concrete buildings would need fewer modifications to sustain their use period.

World War II Facilities

Only 18 WW II facilities existed on HAFB when this assessment was conducted (see Table 10). All of the facilities are located in three currently used locales: the Cantonment Area (n=15, including 13 in the Main Base, 1 in the North Area, and 1 at the Golf Course), Munitions Storage Area (n=2), and Jeep Target Training Area (n=1). All of these areas have been used continually in their original function for the past 55 years.

The WW II facilities were originally associated with a flying mission and consist of storage buildings (n=6), aircraft hangars (n=4), administration offices (n=2), classrooms (n=2), weapons training facilities (n=2), a shop, and a housing unit. The facilities, with the exception of one, are in use for functions related to the current base mission (demolished buildings are discussed by their last function). The continued use and reuse of WW II facilities is apparent from the heavy modification to, and lack of, integrity of most of the properties (n=12, 66 percent).

The 12 buildings lacking integrity are all within the Cantonment Area (12 of 15 buildings, 80 percent, in that area) (Buildings 40, 71, 96, 107, 200, 205, 218, 291, 300, 302, 599, and 754). The 12 buildings lack integrity because of their location in the most heavily used portion of HAFB (11 of 12 are in the Main Base, and Building 754 probably originated there), original construction type, and generic functions. The majority of these buildings (n=9) had nonspecialized or generic designs, single story with gable roofs and interior partitioning, that could easily be modified for a variety of different functions. The other three buildings had more specialized functions as hangars (Buildings 291 and 300) and an indoor firing range (Building 599). Eleven of the 12 buildings were constructed of wood and the majority were either temporary (n=4) or semipermanent (n=7). Eight buildings (67 percent) had been modified for one to six interim functions that differed from that for which they were originally constructed. Only two hangars (Buildings 291 and 300) and two storage buildings (Buildings 96 and 754) were always used for their intended purpose. The location of these 12 buildings in the Cantonment Area and the generic nature of most of them made them convenient for continued use. Almost all of the buildings have been modified with new exterior and interior finishing and roofs. These modifications would have been necessary to keep temporary and semipermanent buildings functional past their expected life span, and also to make them practical for new uses. Ten of these buildings were in use at the time of the current study (three have since been demolished): six for functions other than their original use and four for their original functions. The latter included two hangars and two storage buildings. Two buildings were vacant (Buildings 107 and 200 [now demolished]).

Six facilities, three in the Cantonment Area (Buildings 289, 301, and 1079), two in the Munitions Storage Area (Buildings 1236 and 1237), and one in the Jeep Target Training Area (Jeep Target), have had minor modification and retain their physical integrity. These facilities may have survived major modifications because they were constructed for very specific functions or have always been used for their intended function (not necessitating major modifications). In addition, the North Area and Jeep Target Training Area are no longer associated with the primary base mission and receive less intensive use than the Main Base and West Area. The North Area is currently used primarily by tenant organizations and the Jeep Target Training Area is only used periodically for military training by various 49th FW squadrons. The three buildings in the Cantonment Area include two hangars and a hazardous materials storage building. The two hangars, Buildings 301 and 1079, have had exterior modifications but still retain their feeling as WW II hangars because they have been continuously used for aircraft maintenance. Building 301 was constructed as a permanent facility and Building 1079 was semipermanent. The storage building, Building 289, was also semipermanent and was constructed of hollow clay tiles. The small size and solid construction, as well as a location near the runway, have limited its use to the intended function. Two storage buildings in the Munitions Storage Area are also relatively intact. Buildings 1236 and 1237 were constructed of hollow clay tiles which, when considering Building 289, implies that this construction method was conducive for hazardous materials/munitions storage. Building 1237 is listed as permanent and Building 1236 as semipermanent, which is interesting because they appear to be constructed identically. Both buildings have always been used for munitions storage, probably because of their location. The final intact structure is the Jeep Target located in the Jeep Target Training Area. This earthen berm is so specialized in construction that it could be used for little other than the training for which it was originally designed. Although the type of training has changed, it is still used for that purpose.

Cold War Facilities

In contrast to the WW II facilities, 15 of the 16 Cold War facilities are located in remote areas on the base and have had few modifications and minimal reuse (see Table 10). The 15 Supplemental Area facilities were associated with various test vehicle programs and included nine launch complex support (Buildings 1116, 1127, 1139, 1142, 1440, 1442, JB-2 Ramp, Test Stand, and Incinerator) and six instrumentation or communication related properties (Buildings 900, 1113, 1133, 1249, 1284, and 1285). Only one building, the bathhouse (Building 322), is located in the Cantonment Area. This building is the only Cold War facility currently in full time use for a function other than storage.

The Cold War facilities have seen little use and reuse and all retain historic integrity and convey original design and aesthetic character. While WW II buildings have not retained their integrity, the Cold War facilities have, apparently because of their permanent and specialized construction and their location in areas not reused after the missile programs ended at HAFB. The majority of these facilities (n=12, 75 percent) had designs specific to their use as observation blockhouses (Buildings 1116, 1139, 1142, and 1440), launch/test facilities (Building 1442, JB-2 Ramp, and Test Stand), instrumentation/communication stations (Buildings 900, 1113, 1133, and 1249), and an incinerator, all of which would be difficult to modify for other functions. Only two of these facilities, Buildings 1139 and 1440, had interim functions different from their original use (one interim function each), although information was not available for the three structures (JB-2 Ramp, Incinerator, and Test Stand). Of the four buildings with more generic construction, including CMU or steel walls, only Building 322 is easily accessible in the Cantonment Area, while the other three are in the more remote Supplemental Area (Buildings 1127, 1284, and 1285). None of these buildings had interim functions different from their original use. For the 13 buildings with facility records, 12 were of permanent construction: eight of reinforced concrete (including one with a wooden room attached), one of steel, two of CMU (one with concrete columns), and one of poured concrete. Only Building 1285, a steel storage shed, is of semipermanent construction. The JB-2 Ramp, Test Stand, and Incinerator are of earth, poured concrete, and brick, respectively.

Only two of the buildings are used to any degree today, and both for functions the same or similar to their original use: Building 322 as a Recreation Center/Health and Wellness Center shower facility and Building 900 occasionally as a Navigational Aid station. The remaining facilities are either used for storage (n=5), are vacant (n=6), or abandoned (n=3). The location of the buildings outside areas of heavy use have made them inconvenient for purposes other than storage, which does not require modifications, and they were not demolished to make room for new mission essential buildings. In addition, these concrete and steel buildings show very little wear since their original construction. Finally, most of the buildings are either one or two room, small structures that could not be used for many alternate functions. The three structures—the launch ramp, incinerator, and test stand— are very specialized and it is doubtful that they were used for purposes other than their original function. Almost no modifications other than those made during their time of original use were visible on any of these facilities.

In summary, the remote nature of most of the Cold War facilities and their lack of use other than for storage has saved them from major modifications and they retain much of their structural and visual integrity. Vandalism, such as bullet holes and graffiti, has occurred but is not a major problem.

CONSTRUCTION METHODS

The buildings discussed in this report are grouped into seven structural system types listed in Appendix D. Several patterns emerge when identifying buildings by construction type, property type, and date of completion, which leads to obvious conclusions on decisions governing materials and systems used.

World War II

The base support buildings (Operational and Combat Weapons categories) built ca. 1943 were constructed of wood, usually with stud walls and roof rafters or trusses (Category I). These buildings did not need extra protection (strengthening or hardening) and probably had to be built quickly after the base opened to house the first influx of military personnel. Wood was the best material for these one story structures due to its light weight and flexible characteristics and ease of use as a construction material.

Aircraft maintenance hangars (Combat Weapons category) were built using steel or wood trusses on column or buttress supports (Categories V and I, respectively). Structural frames using trusses are typically designed for buildings requiring large open spaces (systems using repetitive framing, concrete, or masonry are more costly for this type of structure due to the quantities required). The structural frame resists the loads and the wall system is specified based on material availability, cost, and insulation and weathering requirements. The decision to use wood versus steel trusses at HAFB is unclear, except for the desire to obtain a certain roof shape. The arched laminated wood trusses in Buildings 301 and 1079 offer a curved roof profile, while the steel trusses in Buildings 291 and 300 form a gable roof. These structures were built ca. 1942-1943.

Storage buildings (Combat Weapons category) constructed around the time the base opened used structural clay tile walls and wooden roof trusses or rafters (Category VII). Buildings 289, 1236, and 1237 fall into this category and were all built ca. 1943. Although these buildings did not require extra strengthening or hardening, the types of items stored in these facilities (munitions and flammable materials) may have required the extra insulation and fire protection offered by masonry construction. Hollow clay tile has its origins in England in the 1850s and Chicago in the 1860s where it was used in light weight, fireproof construction and ornamental terra cotta, respectively. It was popular because it was lighter than brick and fireproof. The tile was originally used in floor systems and as infill construction in association with steel and concrete frames. With the advent of concrete in the late nineteenth century, hollow clay tile was used as infill for warehouses and also with hard plastered cold storage rooms (because it had insulation value and was moisture proof and easily plastered). Hollow clay tile was used extensively in the U.S. for warehouses between 1890 and 1950 especially with the advent of Mission Revival and Southwest styles that required stucco. This tile was a common construction material on military bases throughout the U.S. during WW II (Joe Freeman and Duane Peter, GMI, personal communication 1998).

Cold War

The three basic structural systems mentioned above, repetitive wood frame, roof truss frame, and structural clay tile (Categories I, V, and VII in Appendix D) were used for buildings completed just before the end of World War II (ca. 1943). It is interesting to note that reinforced concrete and concrete masonry were not used until the early Cold War years (ca. 1946 to ca. 1962). Also, most of the early Cold War buildings surveyed for this report fall under the property type Material Development Facilities that, due to their function, required extra protection afforded by strengthening and hardening. Three unique types of structures deserve a brief explanation of their designed geometry and materials: the blockhouses and missile theodolite towers (Category IV) and the Able 51 launch facility (Category VI).

Blockhouses (Buildings 1116, 1139, 1142, 1440)

There are four buildings termed blockhouses. These structures were obviously built for function only with no architectural embellishments. Except for Building 1440, the walls and roofs are monolithic reinforced concrete with excessive wall and roof slab thicknesses (Category IV). All blockhouses are situated in the vicinity of missile launch pads, with observation windows directly in line with the test areas. The design of the monolithic concrete structures is clear, given what is known about air blast resistant data from field tests, lab tests, theoretical studies, and extensive studies in this field. These structures were specifically designed to consider static and dynamic loads, temperature, radiation, etc. Materials and geometry of components were specified, and wall and roof thicknesses were calculated based on those material properties.

As in the preliminary design of any structure, the building function and the loads that will be imposed on the structure must be understood before the designer chooses the building system and materials. The blockhouses served as observation and control stations for missile launches. Therefore, the launching forces had to be analyzed completely. The launching of a missile (i.e., in motion in the boost phase) produces dynamic loads including impact loads, jet impingement and blast, side loads due to misalignment of the booster thrust, and the possibility of an unbalanced thrust due to misfire (Merrill et al. 1956:376). The effects that these launching forces have on the environment include high transient and sustained accelerations, vibration, smoke and other oxidation products, heat, acoustic noise, and blast waves (Merrill et al. 1956:416). The latter two in particular are considered in the design of blockhouses, which are situated approximately 300 ft from the launching site. Acoustic noise and blast travel in the form of waves in the atmosphere and exert pressure on the structure. Merrill et al. (1956:418) define pressure waves as follows:

> Pressure waves generated in the atmosphere by jet engines are of two types, sustained disturbance called "acoustic noise" which is propagated at sonic velocity, and the discrete thin shock wave often described as "blast" which, because of the temperature rise resulting from extreme pressure, is propagated at a velocity greater than the speed of sound in an undisturbed medium.

Air blast loading contains two major subdivisions: (1) overpressure loading due to the increased hydrostatic pressures which occur behind the shock front, and (2) dynamic pressures due to wind, or mass transfer of air associated with the air blast (Newark 1962:3-1). Blast parameters necessary for loading computations are the peak overpressure, the peak dynamic pressure, the duration of their positive phases, and the shape of the pressure-time curves. These are functions of weapon yield, horizontal range, height-of-burst, and the nature of the ground surface in the vicinity of the structure (Newark 1962:3-2). Peak overpressure acts upon a surface parallel to the direction of propagation of the shock front. The peak reflected pressure results when the blast wave impinges upon the surface, and is consequently a function of peak overpressure and the angle of incidence, the angle between the normal to the surface and the direction of propagation of the shock front (Newark 1962:3-3). The dynamic pressure acts as a drag force on an object as a result of winds associated with the air blast. The time variation of the overpressure and dynamic pressure is an important parameter, needed in order to calculate pressure-time variations used in structural response computations. A typical pressure-time profile for a blast wave in free air usually rises rapidly to a peak value and then quickly decays to a steady state value (Merrill et al. 1956:388). The peak magnitude occurs at the time the pressure arrives at the structure.

The task of the designer is to determine the dynamic response of the blockhouse to the forcing function associated with the above pressures, knowing the weapon yields for specific missiles and the input of varying distances to the firing apron (horizontal range). The building's structural frame may then be defined and apportioned. A completely enclosed, above ground, rectangular structure is the geometry that could be defined with the most confidence when analyzing blast loading (Newmark 1962:5-4). The decision to use reinforced concrete over steel was probably due to a variety of factors. Reinforced concrete offers a lower natural frequency (a low natural frequency to that of the forcing function minimizes vibration), predictable ultimate load carrying capacity, internal damping characteristics, and the ability to design reinforcement for different stresses, giving a more clearly defined response (Smith and Hetherington 1994:281). Reinforced concrete construction allows individual structural members to act together to form an integral frame. The continuity of reinforcement in the walls and roof provides a monolithic structure. This type of system provides better absorption of blast energy and resistance to pressures. Specific arrangements of the reinforcing steel provide better resistance of the structural elements to blast forces. For example, walls should be reinforced symmetrically (about a vertical and horizontal plane taken through the center of the wall) and the main flexural steel laced together. Buildings 1116, 1139, and 1142 all have these design details.

Doors, windows, and other features must also be blast resistant. Of special interest are the windows. The sensitivity of windows to air blast induced cracking is a function of their orientation with respect to size, thickness, and mounting. The original drawings for

Building 1116 specify glass dimensions 24" long by 5" thick by 12" high. The glass was furnished by North American Aviation, Inc. It appears that this glass is laminated with smaller ply thicknesses. Also, the glass is inset from the building's exterior surface. The glass in the blockhouse structures has exhibited high strengths that have sustained extreme peak reflected pressures. Because cracking is likely to be probabilistic in nature, the ability to withstand these pressures is possibly due to the above specifications and the fact there were no surface flaws during these tests, nor did the glass experience fatigue stress. Fatigue stress (stress over time) could be caused by improper connection of glass to structure or repeated shock loading (Stanworth 1953:101).

Missile Theodolite Towers (Buildings 900, 1133, 1249)

There are three identically constructed missile theodolite towers completed ca. 1954 according to Real Property Accountable Records and original construction drawings. These two story monolithic concrete structures (Category IV) were specially designed and constructed to provide maximum rigidity and stability for use of tracking equipment. Cinetheodolite sites were originally located at ground level on the desert floor, which became so hot in the summer that it not only superheated the instrument but produced an optical distortion (known as "atmospheric turbulence"). The blowing gypsum sand also affected instrumentation crews, who had little protection from the elements other than small equipment shacks. In response to these problems, Dr. Ernst Steinhoff recommended construction of two story structures, with electronically operated roofs, in which to house equipment and crews. Kenneth Clark, a Santa Fe architect/engineer, completed the architectural drawings (Kammer 1996:18).

The buildings, as constructed, consisted of two lower stories in which electronic and communications equipment was housed, and a third story framed by a plywood parapet which housed the Askania cinetheodolite mounted on a pedestal. Placement of the cinetheodolite 23 ft above the desert floor reduced the effects of atmospheric turbulence. The concrete foundation and 10 inch thick, reinforced concrete walls reduced the possibility of vibrations that might cause the finely calibrated instrument optics to lose their accuracy. Two concrete cross beams under the second story roof slab helped support heavy instrument and equipment loads. The retractable roof panels offered protection from blowing sand, moisture, and the sun, because they could be kept closed until shortly before the instrument was used. In addition to housing the equipment, the lower stories were cooled by evaporative coolers in the summer and warmed by butane heaters in the winter. This modified the extreme temperatures affecting some of the equipment and offered a comfortable setting for instrumentation crews (Kammer 1996:18-19).

The aluminum roof panels, which are not an integral part of the concrete structure, are of special interest. Missile launch data collection equipment for the missile theodolite towers was housed in a 12'7" x 12'7" area centered on top of the concrete roof slab (the third story). The walls for this area are 3'11" high steel studs clad using ¾" diagonal sheathing under ¾" exterior grade plywood. The roof system for this space consists of retractable aluminum cover segments on aluminum reinforcing beams. There are four retractable roof covers that, when closed, meet at an apex and form a steeply pitched, hip roof. Each cover is in the shape of a thick arrow and has the same assembly as the other covers (see Figure 91). Two I-beam rails support the two angled edges forming the head of the arrow and two H-beam rails support the tail. These rails are mounted on top of a similar beam rail layout with a roller and carrier arrangement. This lower rail system is supported at the bottom by steel braces bolted to the main structure's concrete walls and at the top by steel channels mounted to the concrete roof slab. An aluminum carrier (shaped like an upside down U) is attached to the bottom flange of the upper (cover) rails. Bolts with tapered roller heads are attached to each side of the carrier, spaced so they bear (roll) on the lower support beams' inner flange on both sides of the web. The rolling operation is controlled by a switch that starts a motor to operate a cable coil rotor. The roof may be raised or lowered by respective cables and gear location of the switch (CE File #1249-1, Plate 7).

Able 51 (Building 1442)

Building 1442 (Able 51) was built ca. 1959 and is unique in design and construction compared to other Material Development Facilities mentioned above. The building consists of two bays of bent frames (Category VI). Each bent contains two exterior columns, a shared interior column, and girder rafters. One bay is larger than the other, giving an antisymmetric bent. The column and girder rafter are connected with bolts. It appears all connections are bolted versus welded. The type of connection would indicate whether or not the framing is rigid, semirigid, or simple.

The steel bents increase in height from rear to front, creating an angled roofline along the long axis of the structure. This configuration allows the roof to parallel the missile launching trajectory. It appears this structure was built to shelter the Mace missile before and during a launch. It does not appear that this structure aided in any way to the technical requirements of the launch. In order to sustain possible extreme forces due to firing, the frames were spaced more closely together than would normally be required for a one story steel frame of this type. Also, the connections were over-designed. It is obvious that this building was not intended to be exposed to direct forces, due to the design of the blast exhaust tubes at the rear to divert these forces and the fact that steel was used as the material in the first place. Steel weakens under extreme temperatures as evidenced by the need for the insulation panels.

Conclusion

The decision to use wood as a material for construction for most of the support buildings on HAFB between the time the base opened and before the end of WW II was probably due to its straightforward design and the lightweight, flexible characteristics required for quick construction. Contractors could obtain materials locally and build these one story structures quickly without shipping delays, the possibility of incorrect shipments, or having to interpret complicated details on construction drawings. Future research could determine the availability of lumber in Alamogordo during this time and where the material was obtained. Also, the association of materials specified for temporary and semipermanent structures could be identified.

Maintenance hangars were constructed using materials and systems to achieve floor space and ceiling height requirements. Use of steel frames is natural for these requirements; however, systems using wood trusses supported by concrete buttresses may have been equal in cost and/or erection time. In order to span the long distances, the wood trusses had to have chord and web members with large cross sections or glue-laminated sections. Laminated wood is preferable to large solid wood members due to a controlled moisture content, more dimensionally stable cross section, and better resistance to weather fluctuations. The hangars probably lacked temperature control due to the large space and large (open) doors. Trussed shapes allow longer spans and can be designed to support heavy concentrated loads such as engine hoist systems. The arched shape counteracts the large stresses due to bending moments in the long span and gives additional clear height at the center of the hangar.

The design and review of the early Cold War structures appears to have been very controlled. Preliminary design data and engineering criteria can be found for the missile theodolite towers (theodolite shelters) in the FY53 Public Works Program (Partial Listing No. 2) by the 6540th Missile Test Wing at HAFB. This document also refers to Codes that had to be adhered to. The Commanding General at WSPG approved the preliminary project documents and the Master Planning Board of WSPG reviewed preliminary plans and construction drawings for technical projects located at HAFB. The COE, Albuquerque District, administered the projects (National Archives—Southwest Region: Memo dated Oct. 1952 from the Commanding General, White Sands Proving Ground to the District Engineer, Albuquerque). The Air Force has many technical manuals for specific types of construction. Future research could identify manuals prepared for different building types and compare the as-built design of specific buildings to these designs.

CHAPTER 7

RECOMMENDATIONS

NATIONAL REGISTER ELIGIBILITY

The main objective of the architectural assessments of the 34 WW II and early Cold War facilities is to provide initial evaluations of significance and NRHP eligibility recommendations. The HABS/HAER Level IV documentation provides the information necessary to make such evaluations. Once initial recommendations of eligibility are made, future management considerations for facilities can be determined. NRHP eligibility recommendations vary slightly, depending on whether a facility dates to WW II or the early Cold War years. Although a number of the early Cold War facilities were constructed in 1947 and 1948 and will be 50 years old by the time this report is published, they had not yet reached that mark when they were evaluated and were considered with the younger Cold War facilities.

The 18 WW II facilities are 50 years old and were evaluated using the four NRHP criteria described in Chapter 3: association with historic events (Criterion A), association with important persons (Criterion B), distinctive design (Criterion C), and potential to provide important information about history (Criterion D). The *WW II Permanent Construction, DoD Historic Context* (Whelan et al. 1997) was used as a guideline to interpret the HAFB properties in relation to these NRHP criteria. Initially, the programmatic agreement (PA) between the DoD and the Advisory Council on Historic Preservation, which allows the demolition of WW II temporary structures unless they are part of an historic district (Air Force Instruction 32-7065, Part 3), was also taken into account. This PA concludes that the ". . . historic preservation requirements for World War II temporary buildings . . . have been met. . . . The history has been completed . . . and major building types have been documented . . ." (Flora 1992). The PA is not really applicable, though, because only four temporary WW II buildings remained on HAFB at the time of this study, and they do not retain integrity. The 16 early Cold War facilities, which have not yet reached the 50 year mark, were also evaluated using the four NRHP criteria with the addition of Criteria Consideration G, which takes into account the *exceptional significance* of a property. The USAF *Interim Guidance* provided the guidelines for the evaluations. The contribution of a facility to a significant archaeological site was also considered because most of the Cold War facilities not considered exceptional as individual properties were associated with important missile launch complexes.

Based on the NRHP criteria and Criteria Consideration G, the recommendations were made using the following categories:

1. the seven categories of historic integrity: location, design, setting, materials, workmanship, feeling, and association;
2. the historic context; and
3. the contribution of a facility to a significant archaeological site.

Historic integrity was determined during the field inspections by comparing current features of each facility to attributes recorded on real property records and to the earliest, and sometimes original, engineer drawings (design, materials, workmanship, and feeling). Integrity of location, setting, and association was determined by comparing existing natural and cultural conditions to those illustrated on WW II and Cold War base maps and photographs. The assessment of the significance of a property within its historic context was based on NPS (1991c:7-8) guidelines:

1. Identify the historic context represented by the property;
2. Determine how the theme of context is significant in local, state, or national history;
3. Determine what property types represent the context;

4. Determine how the property illustrates an important aspect of the history; and

5. Determine if the property retains the physical features necessary to convey its significance [historic integrity].

NPS (1991:5-6) guidelines for delineating districts were used for interpreting the contribution of a facility to an archaeological site. The term district has been changed to site so it applies to the current project, because no districts were identified:

1. A [site] may include features that lack individual distinction, if the [site] as a whole entity is significant;

2. A [site] may contain properties that do not contribute to the [site's] significance; and

3. [Site] boundaries are based on the historical and physical associations among the properties, which do not necessarily coincide with current installation boundaries or activity jurisdictions.

The 18 WW II facilities were evaluated as individual properties because, with the exception of the Jeep Target, they were not associated with archaeological sites and were too scattered throughout the base to be considered as a district. The Jeep Target was considered as an individual property because the archaeological site it is located within, HAR-082 (LA 104440), was not eligible for the NRHP. The nature, date, and type of construction, historic appearance, and function(s) of each facility during WW II were documented during the assessment. AAAF's WW II historic context has been fully developed, and none of the facilities were associated with an important event in the war. Therefore, a property was eligible based solely on historic integrity: if its design, materials, and workmanship were an important example of WW II construction, including the distinctive characteristics of the property type and comparison with examples of that type on other bases (Whelan et al. 1997:244).

The 16 Cold War facilities were evaluated as individual properties and, when applicable, on their contribution to archaeological sites. As with the WW II facilities, the individual characteristics of each property were documented during the assessment. The facilities retained all or most aspects of historic integrity. The historic context of HAFB during the Cold War has been fully developed, and 14 of the 16 properties were *directly* associated with events of national importance during that era (Buildings 322 and 1284 were not). Thirteen facilities were within or associated with archeological sites previously determined eligible for the NRHP based on their association with HAFB's contribution to Cold War missile development (Buildings 322, 1284, and 1285 were not). Therefore, a property was eligible based on a combination of its historic integrity, *direct* association with one of HAFB's important Cold War programs, and contribution to a significant archaeological site.

Table 11 illustrates for each property the elements of integrity, context, and association with archaeological sites. The interpretation of these data and final NRHP eligibility recommendations are then presented in Table 12. This table provides consideration of the five NRHP criteria, including Criteria Consideration G for facilities less than 50 years old, and comments for the historic context of the property. Seventeen facilities are recommended as ineligible for inclusion to the NRHP and 17 are considered eligible. Further research is recommended for five of the eligible properties.

Ineligible Properties

Seventeen buildings were considered ineligible for inclusion to the NRHP, including 15 constructed during WW II and two from the early Cold War (see Table 12). HAFB does not retain any feeling from its WW II function as a bomber crew training facility because the few properties from that era are scattered throughout the base. Twelve of the 15 WW II buildings have been modified to such an extent that they no longer retain historic integrity, including three that were demolished soon after they were assessed for this project (Buildings 200, 599, and 754). The remaining three buildings retain physical integrity with very few modifications since their original construction. Buildings 289, 1236, and 1237 are hollow clay tile storage buildings. Building 289 was previously determined to be ineligible for the NRHP because it had

Table 11
Facility Significance

Bldg #	Date	Historic Integrity									Context	Site Contribution	Property Evaluation	
		Location	Design	Setting	Materials		Workmanship		Feeling	Association			Integrity	No Integrity
					Interior	Exterior	Interior	Exterior						
40	43	x	<25%		<25%	<25%	<25%	<25%						x
71	43	x	<50%		<25%	<25%	<25%	<25%						x
96	43	x	<50%		<50%	<25%	<25%	<50%		X				x
107	43	x	<25%		<25%	<25%	<25%	<25%						x
200	43	Demo												x
205	43	x	<50%		<25%	?	<25%	<25%						x
218	43	x	<50%		?	<25%	?	<25%						x
289	43	x	>75%		?	>75%	?	>75%	x	X			x	
291	43	x	<50%	x	<50%	<25%	<50%	<25%	x	X				x
300	43	x	<50%		<75%	<25%	<75%	<25%		X				x
301	44	x	>50%	x	<75%	<50%	<75%	<25%	x	X			x	
302	42	x	<25%			<25%		<25%						x
322	49	x	>75%		?	>75%	?	>75%	x	x			x	
599	43	Demo												x
754	43	Demo												
900	54	x	>75%	x	?	>75%	?	>75%	x	x	Missile testing	Mart site (HAR-018r/LA 107798)	x	

Table 11 (cont'd)

Bldg #	Date	Historic Integrity									Context	Site Contribution	Property Evaluation	
		Location	Design	Setting	Materials		Workmanship		Feeling	Association			Integrity	No Integrity
					Interior	Exterior	Interior	Exterior						
1079	43	x	<50%	x	<75%	<50%	<50%	<50%	x	x			x	
1113	49	x	?	x	?	>75%	?	>75%	x	x	Missile testing	Missile Test Stands Area (HAR-041/LA 104274)	x	
1116	47	x	>75%	x	>75%	>75%	>75%	>75%	x	x	Missile testing	Missile Test Stands Area (HAR-041/LA 104274)	x	
1127	55	x	>75%	x	>75%	>75%	>75%	>75%	x	x	Missile testing	Missile Test Stands Area (HAR-041/LA 104274)	x	
1133	54	x	>75%	x	>75%	>75%	>75%	>75%	x	x	Missile testing	Pritch site (HAR-007/LA 99633)	x	
1139	47	x	>75%	x	>75%	>75%	>75%	>75%	x	x	Missile testing	Missile Test Stands Area (HAR-041/LA 104274)	x	
1142	50	x	>75%	x	>75%	>75%	>75%	>75%	x	x	Missile testing	Missile Test Stands Area (HAR-041/LA 104274)	x	
1236	43	x	<75%	x	>75%	<75%	>75%	<75%	x	x			x	
1237	43	x	<75%	x	>75%	<75%	>75%	<75%	x	x			x	
1249	54	x	>75%	x	>75%	>75%	>75%	>75%	x	x	Missile testing	Sole site (HAR-005/ LA 99457)	x	
1284	48	x	>75%	x	>75%	>75%	>75%	>75%	x	x	Missile testing		x	
1285	50	x	>75%	x	>75%	>75%	>75%	>75%	x	x	Missile testing		x	
1440	62	x	>75%	x	>75%	>75%	<75%	>75%	x	x	Missile testing	Able 51/ZEL site (HAR-075/LA 107799)	x	
1442	59	x	>75%	x	<75%	>75%	>75%	>75%	x	x	Missile testing	Able 51/ZEL site (HAR-075/LA 107799)	x	
JB-2	47	x	<75%	x	<75%	<75%	<75%	<75%	x	x	Missile testing	Missile Test Stands Area (HAR-041/LA 104274)	x	
Test Stand	55	x	>75%	x	>75%	>75%	>75%	>75%	x	x	Missile testing	Missile Test Stands Area (HAR-041/LA 104274)	x	
Incinerator	50	x	>75%	x	?	>75%	?	>75%	x	x	Missile testing	Missile Test Stands Area (HAR-041/LA 104274)	x	

Jeep Target	43	x	>75%	x	<25% >75%	<25% >75%	x	x	Jeep Target site (HAR-082/LA 104440)	x

Table 12
NRHP Eligibility

Bldg #	Date	NRHP Criteria					NRHP Recommendation	Comments
		A	B	C	D	Consideration G		
40	43						Ineligible	No integrity remaining
71	43						Ineligible	No integrity remaining
96	43						Ineligible	No integrity remaining
107	43						Ineligible	No integrity remaining
200	43						Ineligible	Demolished
205	43						Ineligible	No integrity remaining
218	43						Ineligible	No integrity remaining
289	43						Ineligible	Retains integrity, fully recorded
291	43						Ineligible	No integrity remaining
300	43						Ineligible	No integrity remaining
301	44			x			Eligible	Distinctive wood structural system, needs more research
302	42						Ineligible	No integrity remaining
322	49						Ineligible	Retains integrity, not exceptional, need to research commemorative value
599	43						Ineligible	Demolished
754	43						Ineligible	May retain integrity, but has been moved

900	54	x	?	x		x	Eligible	Unique design, associated w/ early missile testing and possibly Dr. Steinhoff

Table 12 (cont'd)

Bldg #	Date	NRHP Criteria					NRHP Recommendation	Comments
		A	B	C	D	Consideration G		
1079	43			x			Eligible	Distinctive wood structural system, needs more research
1113	49	x		x		x	Eligible	Unique design, associated w/ early missile testing
1116	47	x		x		x	Eligible	Unique design, associated w/ early missile testing
1127	55	x				x	Eligible	Association w/ Missile Test Stands Area
1133	54	x	?	x		x	Eligible	Unique design, associated w/ early missile testing and possibly Dr. Steinhoff
1139	47	x		x		x	Eligible	Unique design, associated w/ early missile testing
1142	50	x		x		x	Eligible	Unique design, associated w/ early missile testing
1236	43						Ineligible	
1237	43						Ineligible	
1249	54	x	?	x		x	Eligible	Unique design, associated w/ early missile testing and possibly Dr. Steinhoff
1284	48	x		x		x	Eligible	Unique design, associated w/ early missile testing
1285	50						Ineligible	Retains integrity, not exceptional
1440	62	x		?		x	Eligible	Associated with Able 51/ZEL site, possible unique design/construction
1442	59	x		x		x	Eligible	Unique design, associated w/ early missile testing
JB-2	47	x		x		x	Eligible	Unique design, associated w/ early missile testing
Test Stand	55	x		x		x	Eligible	Associated w/ Missile Test Stands Area

Incinerator	50	x	x	x	Eligible	Possible unique design, associated w/ Missile Test Stands Area
Jeep Track	43		x		Eligible	Possible unique design, more research needed

been extensively recorded through HABS/HAER Level 1 documentation (Ernst et al. 1996). This determination was not changed.

Buildings 1236 and 1237 were considered potentially eligible during their original documentation based on their physical integrity (Tagg 1996). This determination was changed during the current project to ineligible because the buildings do not meet the criteria for significance developed by Whelan et al. (1997:244, 256) for WW II permanent construction. As individual properties they do not possess *important, specific* association with the war or represent an important element of the historic context.

Supporting buildings and structures of secondary importance to the installation mission can be included as contributing elements to a district, but are rarely significant individually. The buildings also do not represent an important example of a particular construction method or type. Hollow clay tile was used extensively for the construction of storage buildings during the war. Finally, munitions storage buildings are a relatively common historic building type. Whelan et al. (1997: II-25, II-26) documented 44 "Storage, Magazine AG (above ground), A, B and C" (Building 1237 - no Base GAR Storage facilities were listed) and 10 "Storage, Spare, Inert" (Building 1236) facilities on USAF bases throughout the country. They also documented 30 "Hazard Stor[age], Base" (Building 289).

The two Cold War buildings considered ineligible, Buildings 322 and 1285, both retain physical integrity but are not exceptional properties because of their original functions. Building 322 was a bathhouse and Building 1285 a storage shed. Building 322 is unusual because it has a commemorative plaque on its principal elevation dedicating the building to military personnel who gave their lives in WW II. This bathhouse is not of exceptional importance to HAFB's role in the Cold War, but the commemorative value of the property should be researched and considered before it is heavily modified or demolished.

Building 1285 is located adjacent to Building 1284 on Tularosa Peak. A series of buildings, structures, and features were located with this complex at one time, most of which are no longer present (see Figures 100 and 102). For that reason, the two buildings were assessed as individual properties rather than as part of a complex. Building 1285 is a prefabricated storage shed that was not part of the originally constructed facility on the peak. It is not considered an important contributing factor to the significance attributed to Building 1284 and the Tularosa Peak complex.

Eligible Properties

Seventeen facilities are recommended as eligible for inclusion to the NRHP. These properties are discussed in three categories: exceptional, eligible through association, and further research needed. Fourteen Cold War properties are either exceptional (n=10) or eligible only through association with significant archaeological sites (n=4). Nine of the 10 exceptional facilities are also within the archaeological sites and would be eligible based on that association, but their significance as individual properties is discussed here. Three WW II facilities are eligible but need further research.

The 14 Cold War facilities are recommended as eligible based on their association with HAFB's role as an early missile development center. The mission conducted at the base made a major contribution to the USAF's role in the early Cold War. Between 1947 and 1962, there was a transition from dependency on a strong bomber force to the development, testing, and use of strategic missiles. In this era of confrontation with the U.S.S.R., the USAF was responsible for maintaining a global offensive weapons capability to stay ahead of the other superpower in the arms race. HAFB was one of the bases where much of the technology was being developed. With the exceptions of Building 1284 and the Incinerator, the facilities are located within archaeological sites that have either been determined eligible or potentially eligible for the NRHP (see Tables 3 and 12). Ten facilities, as individual properties, exhibit exceptional importance in design characteristics. Buildings 1116, 1139, 1142, and 1442, and the JB-2 Ramp and Test Stand are thought to be the only examples of the functional type with their particular construction method and style in the U.S. Buildings 900, 1133, and 1249 (the missile theodolite towers) appear to be unique to southern New Mexico with examples only on HAFB and WSMR. They also may be associated with the important German scientists Dr. Ernst Steinhoff. Building 1284 is important because of its location on Tularosa Peak, its communications role in early missile testing, and its Cold War architectural style. Four additional facilities are significant because of their association with the MTSA and Able 51: Building 1113 and the Incinerator may be exceptional as individual properties, but too little is known about them to make such a determination; and, Buildings 1127 and 1440 are not unique facilities or exceptional as individual properties.

Three WW II facilities (Buildings 301 and 1079 and the Jeep Target) are recommended eligible because they retain historic integrity and may possess unique features. The facilities represent the finest examples of WW II architecture left on HAFB from that era. The hangars possess wooden structural systems that vary from the steel truss systems seen in most WW II hangars. The Jeep Target appears to be a unique training facility. Further research is recommended for these facilities to determine if they are significant at a national, or just local, level.

Exceptional Properties

Buildings 1116, 1139, and 1142 are monolithic concrete observation blockhouses located within the MTSA, a NRHP eligible archaeological site. They may represent the only examples of their particular design and construction in the U.S. They were associated with the Nativ, Gapa, and Aerobee programs, respectively. Comparative data on launch facilities from other installations are limited, but what little data were located indicate that the HAFB blockhouses are unique in their construction. Research has been completed at missile complexes with concrete blockhouses on Eglin AFB, Hill AFB, and WSMR. Eglin and Wendover Army Air Fields (Eglin and Hill AFBs, respectively) conducted tests on the Gapa and JB-2 during WW II and into the early Cold War before programs were transferred to AAAF. WSPG (WSMR) was involved with a variety of test programs in 1945, including the Aerobee rocket before that program began at HAFB in the late 1940s.

Of the blockhouses at other bases, only those at WSMR are similar, albeit larger, than those at HAFB. The WSMR blockhouses have inset windows and high hip roofs like the HAFB buildings. They are much larger (exact sizes are not known), though, and have horizontal ridges/grooves dividing the roofs into three sections. The Army blockhouse at Launch Complex (LC)-33 was constructed by the Fortification Division of the COE in 1945 for the Hermes A-1 missile program. The Navy blockhouse at LC-35 was constructed ca. 1947 for Aerobee missile launching. It followed the original construction plans for the Army blockhouse and is identical to that structure (Eidenbach et al. 1996:72-73, 144-145). It is interesting to note that HAFB’s Aerobee launch tower was transferred to LC-35 in the mid-1960s after that program ended at HAFB.

The blockhouses used at Eglin and Wendover AAFs are different from those at HAFB, being small with flat roofs. Archaeological work and historic research was completed on JB-2 sites at Eglin AFB, which were used between 1944 and 1946 (Thomas et al. 1993). Two JB-2 launch complexes have identical concrete blockhouses which are small, flat roofed bunkers. A JB-2 complex in operation on Wendover AAF between 1945 and 1946 is currently under investigation by the NPS (Greene and McChristian 1997). This complex has a 21' x 21' x 6' semisubterranean concrete control bunker with 3' thick walls. It has slotted windows and a framed doorway (Greene 1997). This building sounds very similar to the bunkers at Eglin AFB.

An early Gapa launch site, currently administered by the BLM in Utah, was nominated to the NRHP in 1980 (Moore 1980). The facility was used at Wendover AAF between June 1946 and July 1947 before the program transferred to HAFB. The site consists of a 40' square reinforced concrete, semisubterranean blockhouse and a 100' square concrete firing apron. The blockhouse is similar to those at Eglin AFB and on the Wendover JB-2 site with a flat roof and dirt berms on each side. The inset, trapezoidal-shaped viewing windows, though, are very similar to those in the HAFB Gapa blockhouse (Building 1139).

Two HAFB launch facilities, Building 1442 and the JB-2 Ramp, are of unique design and construction. The JB-2 Ramp is located within the Nativ complex in the MTSA. JB-2 ramps have been documented on Hill and Eglin AFBs, but even though the HAFB ramp was used for the same program, its earthen construction varies from those used on the other bases. The ramps represent a continuum of the JB-2 program in the U.S. The JB-2 was first tested at Eglin AAF, Florida, in 1944. Because the rockets were launched into the ocean and could not be retrieved for examination, however, the program was moved to Wendover AAF in June 1945 where it continued into late 1946 (Greene 1997). In late 1947, the program, although canceled, was transferred to AAAF for a few final launches.

Two ramps used between 1944 and 1946 have been documented at Eglin AFB (Thomas et al. 1993). One consists of concrete pylons which once supported a metal superstructure for a 400 ft long ramp. Historic photos indicate the rails were situated on the freestanding superstructure. The second launch facility apparently had two concrete pads for portable 50 ft long launchers. Three launch ramps were at the JB-2 complex operated at Wendover AAF between 1946 and 1947. Greene (1997) describes the ramps as ". . . comprised of two rows of concrete piers mounted by an inclined steel ramp bearing parallel rails and built to direct the missiles into the salt flats southeast of the site." He also mentioned the use of mobile launch ramps. The three ramps were further described by Greene (1997):

> The easternmost ramp was used for launching intermediate range rockets. The westernmost ramp was a high angle launch measuring approximately 325' long; its remains consist of ten circular pier ramp supports. Steel bolt plates are present on the piers, as are concrete walls placed lengthwise between the rows of piers to help strengthen them. . . . Between them is the site of a third ramp, a low-angle launch ramp that is now completely destroyed with its concrete pieces scattered nearby.

Building 1442, within the Able 51 site, is the only facility of its type known to exist on USAF bases. It consists of two open launch bays of bent frames. Research indicated the building, called a hardsite, was constructed to protect an aircraft from the effects of a nuclear blast. Zero length launchers within the bays could then send the aircraft airborne, without the need for a runway, to meet the next wave of enemy bombers (Mattson and Tagg 1995). This building is a unique example of an early Cold War facility designed during a time when the threat of nuclear attack was a major concern. No evidence of similar buildings has been located, although it is known that ZEL launchers were also tested in Germany (Smithsonian Institution 1994). The Able 51 archaeological site was previously recommended as potentially eligible for the NRHP. The site is now considered eligible based on the research conducted for the current project.

The Test Stand is located near the Aerobee launch complex in the MTSA. As discussed earlier, Weitze (1997:65) identified the feature as a possible unfinished Thor/Atlas components static test stand. The HAFB feature is 40 percent the size of an Atlas-A launch pad and Test Stand (TS) 1-A at Vandenberg and Edward AFBs, respectively, but its components (concrete flame deflector/water tank and deluge basin) are distinctive for Thor/Atlas wet tie-down (captive) testing. Based on photographs of the Edwards TS 1-A facility, HAFB's Test Stand appears to be an identical, albeit smaller, version of the concrete flame deflector. Although the exact nature of the Test Stand has not been verified, its unique construction and resemblance to the larger California structures, potential to be a prototypical static test, and association with the decision at one time to make HAFB an ICBM test base, make it an exceptional property.

The three missile theodolite towers (Buildings 900, 1133, and 1249) are unique instrumentation facilities and part of a large network of complexes on HAFB and WSMR used for obtaining data on missile launches. They are all features within NRHP eligible archaeological sites. The two story, concrete buildings have retractable aluminum roofs that protected the Askania cinetheodolites when they were not in use documenting missile launches on the range. The buildings may represent the end result of a suggestion by Dr. Ernst Steinhoff, a prominent German scientist working for WSPG at the time, to modify existing ground level instrumentation facilities by elevating them and providing protection from the elements (Weitze 1997:36, 76). Only eight such buildings are known to exist, three on HAFB and five on WSMR (Kammer 1997:19). Their unique design and possible German influence make these buildings an exceptional example of early Cold War instrumentation stations.

Building 1284 is also an exceptional instrumentation facility that was part of the data collection network. The facility consists of a concrete frame of pilasters and spandrels with a flat concrete roof and concrete infill. This was an experimental type of construction used to create nuclear blast resistant buildings. The concrete frame was intended to survive a nuclear blast, while the infill would be destroyed and then rebuilt. It seems this concept was derived before the full effects of a nuclear blast and radiation were understood (Lewis and Staley 1994:30). Building 1284, situated on the top of Tularosa Peak, was one of the primary instrumentation facilities located on HAFB; these facilities were often located on prominent peaks throughout the Tularosa Basin. The building may also have been used as a support facility for the HSTT. According to HSTT employee Dennis Belknap (1996 personal communication), Building 1284 was one of three ground stations that carried channels of information from sleds to the Midway recording building (Building 1161, the main data recording facility at the Track) during track tests from ca. 1948 to the present (Facility Assessment Form/1284).

Properties Eligible Through Association

Four facilities are eligible because of their association with the MTSA and Able 51 launch complexes. Building 1113 and the Incinerator may be of unique construction and be exceptional as individual properties. Without historic documents, however, the degree of modification or their historic integrity can not be determined with certainty. Buildings 1127 and 1440 are not exceptional as individual properties.

Building 1113, located just west of the Nativ and JB-2 complex, was one of a series of communications distribution facilities located throughout the HAFB and WSMR Supplemental Area in support of missile testing. The building is constructed of poured concrete, a common Cold War construction method, but is thought to be unique because it is the only known semisubterranean facility not directly associated with the HSTT. The building was constructed in 1949 during the height of missile testing at the MTSA, and was undoubtedly an integral part of the programs conducted there. The Incinerator is located 8/10 mile southeast of the MTSA and has been linked with the Aerobee program through interviews with previous HAFB employees (Radian Incorporated 1993). The brick-constructed feature may be a unique example of rocket fuel burning facilities.

Building 1127, in which Falcon missiles were assembled, is located within the JB-2/Nativ launch complex of the MTSA. With the exception of one room of concrete and the other of wood, the building does not exhibit unique architecture. The building has a direct association with the JB-2 launch ramp because the Falcon missile was launched using that feature. Building 1440 is a small concrete observation shelter located adjacent to the Building 1442 launch facility at Able 51. The bunker, with its flat roof, is similar to those documented at Eglin and Hill AFBs and does not have the unique design of the MTSA blockhouses. Building 1440 is directly associated with Building 1442, operating as the observation/control center for that facility after the original semisubterranean shelter was demolished.

Eligible Properties Needing Further Research

The three WW II facilities are aircraft hangars (Buildings 301 and 1079) and the Jeep Target. They have been modified to some extent but retain a high degree of physical integrity. These facilities are recommended as eligible because of their potentially unique construction, but further research into these property types is necessary to determine if they are indeed significant. Buildings 301 and 1079 are the best preserved WW II hangars remaining on HAFB and are the only extant properties that represent the base's use and maintenance of Heavy and Very Heavy bombers during the war. The hangars have had extensive exterior modifications, but they retain their open bay scope and general war-era appearance, and their large slider doors and interior finishes are intact. The hangars appear unique because of their arched laminated wood trusses. Hangars generally had steel trusses to achieve the floor and ceiling space needed to facilitate large bombers. It is possible wood was used to provide the curved roof profile: the hangars with steel trusses have gable roofs. It is also possible wood was used because it was readily available in the Sacramento Mountains just east of the base and met the requirements provided by steel construction. The hangars have original listed functions of Field Maintenance Hangars, a property type not listed by Whelan et al. (1997:II-25 - II-30), so it unknown how many still remain in the U.S. The type 'HG, Maint' may represent maintenance hangars, though, and 58 of these properties exist on USAF bases.

The Jeep Target was used for training bomber turret gunners. It is located in an archaeological site that is ineligible for the NRHP. The earthen berm feature retains physical integrity and was unique in its function. This feature is also one of the few WW II facilities remaining on HAFB that illustrate the base's aircrew training function during the war. As with the two hangars discussed above, further research should be conducted to locate similar features on other military bases in the U.S. The best example of a Jeep Target on a USAF base should be protected. If the HAFB feature is not the best example, it would be considered ineligible. However, if no other such features can be found, the HAFB facility is eligible as an example of a unique training feature.

It is known that a series of these dirt berm features exists near Nellis AFB in Las Vegas, Nevada, on USAF and BLM property (Knight and Leavitt 1992). Eight large and one small triangular-shaped berms are part of the Moving Target Range constructed during 1942 and 1943 at the Las Vegas Army Gunnery School (site 26CK4803). The large features, for which original construction drawings were located, are most similar in size and shape to the HAFB Jeep Target. The Nellis features are more triangular in shape and have 150 degree radius curves with a long side of 1,500 ft and short sides of 960.47 ft. The dirt embankments are 4 ft high. Knight and Leavitt (1992) indicate that ". . . the site is in terrible condition and has lost much of its integrity." In contrast, the HAFB Jeep Target, although roughly triangular, has a flat rather than rounded apex. It is smaller than the Nellis features with a long embankment of only about 1,330 ft and short sides ranging in size from about 640 ft to 715 ft, but the berm is higher at approximately 8 ft. Even with the variations in size and shape, the HAFB and Nellis features were unquestionably used for the same purpose, that of training aircrews in the use of .50 caliber machine guns and turrets. The HAFB track is in good condition, although associated features have been impacted by 50 years of military training in the area.

FUTURE RESEARCH

Research is conducted to answer questions on a particular subject, but in many cases it leads to more questions and the need for further research. For that reason, recommendations for future research are provided here. This suggested research relates directly to the properties investigated during the current project and to architectural assessments on HAFB as a whole.

WW II Facilities

The WW II facilities were evaluated as individual properties based solely on their physical integrity. Three of these properties, Buildings 301 and 1079 and the Jeep Target, were recommended as eligible for the NRHP because they retained integrity and their design and construction methods were consider unique based on current knowledge. During WW II, boilerplate construction methods were necessary to establish and quickly build the many new bases needed to support the war effort. For that reason, many WW II-era facilities are identical on bases throughout the U.S. It is unrealistic to think that all such buildings still retaining integrity can, or should, be preserved unless they are important from a regional or local view. Little data was recovered on hangars or turret gunner training facilities from other facilities in the U.S. It is recommended that an effort be made to determine whether other examples of hangars with wood structural systems and curved roof profiles, such as Buildings 301 and 1079, or earthen berm Jeep Targets exist elsewhere in the U.S. The best examples of these types of facilities should be nominated to the NRHP and preserved. ACC is currently completing a research project on hangars, due for publication at the end of 1998, which may supply the necessary data to better evaluate the HAFB hangars (Paul Green, HQ ACC Cultural Resources Manager, personal communication 1998).

Research for the Jeep Target should focus on Army Air Forces bases that trained bomber crews or gunners, such as Las Vegas Army Gunnery School in Las Vegas (now Nellis AFB), which might have similar features. If better examples of the hangars and Jeep

Target exist elsewhere, the HAFB properties should be recommended as ineligible. In this case, HAFB may still want to preserve these three facilities on the base as a legacy to its initial WW II mission. More research should also be conducted on the archaeological site containing the Jeep Target. This site, HAR-082 (LA 104440), was considered ineligible for the NRHP when it was first documented. It consists of a number of military features that may relate to the original use of the bermed feature, possibly representing turret positions, maintenance areas, or structures. If the features are related, the significance of the site should be reconsidered.

Additional research should also be conducted for Building 1079 to explain the sign at its principal elevation stating the building was established in 1935. Construction did not begin on AAAF until 1942, and data located for this report indicates the Building 1079 was constructed that same year. No buildings or cultural features (such as a civilian runway) can be seen on 1941 aerial photographs of the AAAF area prior to base construction. It is unlikely that the hangar was constructed elsewhere and moved to its current location, so the sign remains a mystery.

Building 322 Swimmer's Bathhouse

Building 322 has been recommended as ineligible for the NRHP, but further research should be conducted on the property before it is renovated or demolished. A sign on the principal elevation indicates the building was constructed by WW II military personnel as a memorial to airmen who lost their lives in the war. Although the building is not of exceptional importance as a Cold War facility, it may retain significance as a memorial. Its location next to Heritage Park, with static aircraft displays and a POW/MIA memorial, also makes the building ideal for reuse as a museum or interpretive center.

Cold War Missile Complex and Communications/Instrumentation Facilities

Research has been conducted on the many missile-related complexes on HAFB. Mattson and Tagg (1995) focused their work on programs associated with known archaeological sites. Weitze (1997) expanded on that work with research on the wide variety of test programs conducted on HAFB, including those not associated with physical remains. During the latter study, a wealth of information was uncovered on the missile complexes studied in the first project. Many features on the MTSA with unknown functions were identified and new avenues of data were uncovered that might help identify other features on that and other sites.

Recently, GMI archaeologists rerecorded the MTSA, which is the most important and unique Cold War site on the base (Sale 1997). They located and numbered additional features (174 features have been identified), produced scale drawings of the more complex features, and updated the site map and Laboratory of Anthropology site form. Using this data, it is recommended that an effort be made to identify the unknown features and associate them with the various test programs conducted at the complex. As mentioned above, a number of features can now be identified from Weitze's (1997) work. Many military employees who worked on the site still live in the Alamogordo area. They could undoubtedly also add valuable information. In addition, very few historic photos of the MTSA exist at HAFB. Collecting photos from the National Archives and Maxwell Museum and adding them to the HAFB collection would greatly enhance our knowledge of the site. This same type of research should also be conducted on other missile complexes with unknown features or little historic data such as Able 51.

One missile related facility which rates individual attention is the Test Stand. Weitze's identification of the possible function for this structure raises the question of the types of testing that may have been conducted at the MTSA once the better known programs (JB-2, Nativ, Gapa, Aerobee, and Falcon) ended. This structure definitely warrants research to uncover drawings and data to determine its exact function (was it a new prototype) and whether it was ever used. The 1955 construction date was based on the possibility that the Test Stand was one of many features constructed and abandoned during HAFB's initial build-up in preparation to receive the ICBM program. When testing was shifted to California, many partially constructed test stands were abandoned. The westernmost concrete pad at the feature bears the inscriptions "WDN 4/11/64" and "64 HORST."

Another building on HAFB, Building 1251, bears an inscription similar to the latter name in a concrete door stoop: "A L HORST DEC 65" (HAFB Cultural Resources archaeological site files, HAR-207/LA 109119 site form). This building is located in an area that saw construction during 1954 and 1955 as part of the ICBM buildup, but the Real Property Accountable record (1251) indicates a 1965 construction date for it, verifying the 'DEC 65' in the inscription. This implies that the '64 HORST' in the Test Stand inscription may represent 1964, and "WDN 4/11/64" seems to verify this, which raises a number of questions. Was the Test Stand constructed at that later time, or was the concrete pad a later addition? If the feature was constructed in 1964, what program(s) was it used for? More research is needed to answer these questions. "Sandia Base 609 No. 4th St. Albuquerque" is stenciled on a metal cylinder near the structure, so Sandia National Laboratory should be contacted to begin the search for data.

The communications and instrumentation facilities have received far less attention than the missile programs. Mattson and Tagg (1995) and Weitze (1997) discuss instrumentation facilities because of their important support functions, but provide little detail except for the missile theodolite towers and Askania cinetheodolite camera. Building 1264 on Tularosa Peak and Building 1113 within the MTSA were part of the "most sophisticated data collection system in existence" (Land-Air Division 1979:4): the former (Jig-1) provided missile test telemetry data and communications support and the latter (Queen-2) was one of a series of communications distribution facilities (see Figure 86). More archival research into this vast missile support system would be a valuable addition to the HAFB Cold War database. In addition, both buildings warrant individual research. No construction drawings and little data were located for Building 1113 and data were scarce for Building 1284 (copies of more recent drawings were found in the Real Property files, but none existed in the drawing vault). Both buildings possess construction and design methods unique on HAFB: Building 1113 is semisubterranean and Building 1284 is pilaster and spandrel. Why is Building 1113 semisubterranean? Was this considered protection against nuclear attack, or just from the effects of nearby missile launches? If the latter, why were observation blockhouses closer to the firing aprons completely above grade? What is the history behind the atomic bomb proof pilaster and spandrel construction method? Was Building 1284 used as an experiment for this type of construction, or was it common for Cold War facilities? Although both facilities are recommended as eligible for the NRHP, answering these questions and compiling more data on the properties will add to what is already known about Cold War construction methods on HAFB.

More research is also necessary to identify the functions of features at the missile theodolite sites and document additional features on Tularosa Peak. The Mart and Sole missile theodolite sites both have a number of concrete pads and other features whose functions were not determined during previous work. Further research would help determine if these features are contributing elements to the sites or are later intrusions that have no significance. As illustrated in Figures 100, 102, and 105, Tularosa Peak once contained numerous buildings and features in addition to Buildings 1284 and 1285. The two extant buildings were recorded as individual features during this assessment. The top of Tularosa Peak may be considered an archaeological site or complex and the features on this prominence should be mapped and identified. If the entire complex is determined to be significant, Building 1285 would be a contributing element and its NRHP eligibility should be changed to ensure its protection.

Further Facility Assessments

The architectural assessments conducted for this report and by Fulton and Cooper (1996) resulted in the documentation and NRHP evaluation of all HAFB facilities constructed between 1942 and 1955 that are listed on Real Property records. Some facilities not on real property lists or built after 1955 have also been investigated. These studies included all properties from WW II, or that are 50 years old (except for housing units), and those Cold War facilities that fit the USAF's *Interim Guidance* categories of significance: possession of exceptional value or quality in illustrating the Cold War heritage; *direct* association with significant Cold War activities (the actual launch or research facilities); and, embodiment of the distinguishing characteristics of an architectural, engineering, technological, or scientific type specimen *exceptionally valuable* for the study of that period. There are still many Cold War facilities, though, in need of documentation. Not all properties constructed prior to 1989 should be evaluated. Over half of the remaining facilities consist of housing units and support buildings that would not qualify as directly associated with the Cold War, and would have little potential to be exceptional. Most of these facilities will not reach the 50 year mark for another 20 years.

The current project was designed to evaluate all 1940s buildings and a number of obviously significant Cold War properties. The second project focused on all properties constructed between 1950 and 1955 regardless of their historic function. The goal of future projects should be to categorize the remaining Cold War properties by function and begin assessing those that may fit into the USAF *Interim Guidance* historic significance criteria. The initial process will consist of reviewing a current list of Real Property constructed prior to 1990, and determining the original function of these facilities from the Real Property Accountable records. All properties associated with early missile development and instrumentation/ communications should be assessed using the HAFB facility assessment form (HABS/HAER Level IV documentation). Initially, those resources that have been determined to have a low probability of being exceptional properties should be eliminated from consideration. These would include housing units, base exchanges, administrative buildings, garages, and motor pools. If, at some time in the future, these properties reach the 50 year mark or funding is available for further assessments, they can be considered. Special attention should be given to buildings being considered for demolition. This process should continue until all Cold War properties on HAFB with even the slightest potential to be exceptional have been assessed, documented, and evaluated.

FACILITY MANAGEMENT AND PRESERVATION

The assessment and evaluation of buildings and structures on HAFB are just the first, and perhaps easiest, steps in managing this type of cultural resource. Once many of these facilities have been formally recognized as being eligible for the NRHP and become historic properties, HAFB managers have a responsibility to maintain and preserve their integrity as required by federal law. The Secretary of the Interior is responsible for advising federal agencies on the preservation of properties listed on or eligible for inclusion to the NRHP. In partial fulfillment of this responsibility, the *Secretary of the Interior's Standards for Rehabilitation* (36 CFR 67, hereafter referred to as *Standards*) were developed to guide work on historic buildings, structures, and sites (NPS 1983; Weeks and Grimmer 1995). The *Standards* emphasize the continued usefulness of historic properties to fulfill the mission of the USAF. Rehabilitation is defined as "the process of returning a property to a state of utility, through repair or alteration, which makes possible an efficient contemporary use while preserving those portions and features of the property which are significant to its historic, architectural, and cultural values" (Wagner 1996:2).

The intent of the *Standards* is to assist in the long term protection of a property's significance through the preservation of its historic materials and features. This relates to all aspects of the property, associated landscape and cultural features, the surrounding environment, and all aspects of an historic district (including items such as roads and sidewalks). To comply with the standards, any changes to the historic property must be determined to be consistent with the historic character of the building, structure, or district. Alterations can occur, as long as they do not damage or destroy (adversely effect) materials, features, or finishes important to the property's historic or architectural integrity (Wagner 1996:2-3). The *Standards* cover all aspects of property maintenance and preservation (Wagner 1996:3):

1 A property shall be used for its historic purpose or be placed in a new use that requires minimal change to the defining characteristics of the building and its site and environment.

2. The historic character of a property shall be retained and preserved. The removal of historic materials or alteration of features and spaces that characterize a property shall be avoided.

3. Each property shall be recognized as a physical record of its time, place, and use. Changes that create a false sense of historical development, such as adding conjectural features or architectural elements from other buildings, shall not be undertaken.

4. Most properties change over time; those changes that have acquired historic significance in their own right shall be retained and preserved.

5. Distinctive features, finishes, and construction techniques or examples of craftsmanship that characterize a property shall be preserved.

6. Deteriorated historic features shall be repaired rather than replaced. Where the severity of deterioration requires replacement of distinctive features, the new feature shall match the old in design, color, texture, and other visual qualities and, where possible, materials. Replacement of missing features shall be substantiated by documentary, physical, or pictorial evidence.

7. Chemical or physical treatments, such as sandblasting, that cause damage to historic materials shall not be used. The surface cleaning of structures, if appropriate, shall be undertaken using the gentlest means possible.

8. Significant archeological [sic] resources affected by a project shall be protected and preserved. If such resources must be disturbed, mitigation measures shall be undertaken.

9. New additions, exterior alterations or related new construction shall not destroy historic materials that characterize the property. The new work shall be differentiated from the old and shall be compatible with the massing, size, scale, and architectural features to protect the historic integrity of the property and its environment.

10. New additions and adjacent or related new construction shall be undertaken in such a manner that if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired.

Guidelines are provided for applying the *Standards* to historic USAF buildings and structures. They are intended to provide general guidance for installation Cultural Resource Managers, maintenance personnel, and others involved in the management of historic properties. These guidelines address exteriors and interiors of facilities constructed of a wide range of materials (such as masonry, wood, and metal) and procedures on how to identify, retain, preserve, protect, maintain, repair, replace, and alter/add, as well as design for missing features. There are also sections on energy efficiency, base plan and the historic landscape, new construction in historic districts, archaeological resources, accessibility considerations, and health, safety, and security considerations (Wagner 1996:4-8).

In addition, the NPS has prepared reading lists with references for publications pertaining to the maintenance and preservation of specific construction materials that should be consulted before working on any historic property. These include *Twentieth Century Building Materials: 1900-1950* (Bleekman et al. 1993), *Preserving Wood Features in Historic Buildings* (Avrami 1993), *Historic Masonry Deterioration and Repair Techniques* (Carosino et al. 1993), *Historic Concrete* (Cowden 1993), and *Painting Historic Buildings: Materials and Techniques* (Bevil et al. 1993).

The *Standards* and guidelines and the applicable NPS maintenance publications should be applied to the historic properties identified during the current project. Recommendations for this application to the 34 WW II and early Cold War facilities are provided below, as are suggestions for currently needed maintenance to preserve the facilities' integrity. Alterations to any of these facilities, unless otherwise noted, shall be preceded by consultation with the SHPO.

Ineligible Properties

Seventeen facilities have been recommended as ineligible for the NRHP. Three of these have been demolished since this project was conducted (Buildings 200, 599, and 754). The 14 remaining facilities have been removed from further management consideration and can be modified or demolished without additional documentation or planning.

Eligible Properties

Seventeen facilities have been recommended as eligible for the NRHP and require consultation with the SHPO before they are modified or upgraded for current or future use. Thirteen of these facilities are located in NRHP eligible archaeological sites that need to be considered when planning work on the individual properties. The following discussion provides recommendations for each property in terms of maintenance for current problems and considerations for future use.

Archaeological Sites

Six archaeological sites are associated with 13 of the facilities discussed below, including the Sole site (HAR-005), Pritch site (HAR-007), Mart site (HAR-018r), MTSA (HAR-041), Able 51 (HAR-075), and Jeep Target (HAR-082) (see Table 3). Four of the sites are currently considered eligible for the NRHP, one is potentially eligible but should be recommended as eligible from the data provided in this report (HAR-075), and one is ineligible but needs further research (HAR-082). The sites consist of from one to seven extant facilities and from six to 174 features. As mentioned in the *Standards*, these sites must be considered when conducting any work on the facilities. It is unlikely that any of the sites contain subsurface cultural deposits, so surface features should be protected and preserved, or intensively documented, drawn, and photographed if there is potential for their disturbance.

None of the sites receive extensive use because of their locations away from the Cantonment Area. Military exercises have occurred at the Sole site, Jeep Target, and Able 51. The MTSA, Mart site, and Able 51 are visited by personnel using the various buildings for storage. The major impacts on the facilities and features at these sites are vandalism and military exercises. The sites should be visited on a regular schedule to discourage vandalism and monitor the effects of weathering. Military personnel should be made aware of the significance of the buildings and sites in those areas where they conduct exercises.

Facilities

The three WW II facilities have been modified but still retain the essential design elements that are characteristic of their original function. The facilities are currently in use for their historic purpose and are maintained to retain this usefulness.

The fourteen Cold War facilities retain all of their essential design elements and have had few or no structural or architectural modifications to the exteriors or interiors with the exception of removal of equipment. The *Standards* recommends that a property be used for its historic purpose or placed in a new use that requires minimum changes to the facility. It is unlikely that most of the Cold War facilities will ever be used again for their historic functions, because missile testing and the need for instrumentation facilities in remote areas is long past. The two structures, JB-2 Ramp and Test Stand, retain no value for further use because of their specialized construction. The location of the buildings in remote areas away from the Cantonment Area and their small size also makes them unlikely candidates for current mission related use. In most cases, they are used for storage or are vacant/abandoned. Storage is an ideal reuse for most of the buildings because it is nondestructive and requires no modifications to the facility because only the interior space is needed for storage activities and equipment. Unfortunately, storage buildings rarely receive periodic maintenance and deteriorate through time. This also occurs if a building is abandoned. For that reason, these facilities require special attention at a base level to ensure they do not lose their integrity through neglect. They should be periodically inspected and minor deficiencies repaired so they maintain their distinctive features and defining characteristics. If possible, the intact design elements shall be preserved. If maintenance is necessary, historic features should be repaired rather than replaced. When windows or roofs need replaced, the new feature shall match the old in design and, where possible, materials. This replacement should be well documented. NPS Preservation Briefs should be consulted for proper methods in tasks such as graffiti removal from concrete.

Building 301

This building has been extensively modified architecturally at the northwest and southeast elevations, but the principal (northeast) and southwest elevations and the interior remain essentially as they were originally constructed. The exterior has been covered with corrugated metal and almost all original windows and doors have been replaced. The essential design elements characteristic of the building, such as the large slider doors, exposed wooden truss system, uninterrupted clear space, and the beaded, tongue-and-groove sheathing at the exterior office walls, are intact. These elements should be considered and preserved during future maintenance/modification projects. Future modifications to the northwest and southeast elevations and the office interior will not compromise historic integrity due to extensive alterations (Facility Assessment Form/301).

Most of the maintenance problems noted at the building include lack of paint and water leakage/damage. Scraping, priming, and painting are needed for the roof ladders, louvers and wood at the slider door pockets at the northeast and southwest elevations, and the safety zone at the base of the brick boiler room flue at the southeast elevation. All air conditioner and cooling (HVAC) units need to be inspected for leakage and moisture-retaining debris needs to be removed from around the foundation. The northwest elevation HVAC unit leaks, there is water infiltration at the southwest corner, and moisture damage was noted at the building interior. Pigeons roosting in HVAC units are causing damage to the roll roofing at the clerestory and need to be removed (Facility Assessment Form/301). Building 301 continues to function as a maintenance hangar for aircraft, and should remain in use for this or similar functions to ensure minimal changes in its defining characteristics.

Building 900

No major structural modifications were noted for this building and it is the most intact missile theodolite tower on HAFB. The interior was not accessed, so its condition is unknown. This building does not need any noticeable maintenance or repair and is in excellent condition. Building 900 is used periodically by WSMR personnel as a Navigational Aid Station, a use which parallels its historic function and should require little or no modification to the original features.

Building 1079

This building has been extensively modified architecturally at the exterior: original wood lap siding has been replaced with metal, windows and personnel doors removed, openings added, and the slate roof replaced with roll roofing. The interior remains relatively intact including the laminated wood trusses, wood columns and cross bracing, concrete buttresses, and large open floor plan. The large slider doors at the principal elevation and arched roof also remain intact. These doors and the interior should be considered and preserved during future maintenance/modification projects. Future modifications to the exterior, with the exception of the principal elevation and arched roof, will not compromise historic integrity due to extensive alterations (Facility Assessment Form/1079).

The building remains in good condition. Vegetation should be removed and sinkholes filled along the foundation at all elevations. The wood soffitt at the north elevation needs patched and painted. Building 1079 continues to be used as a maintenance hangar for aircraft, and should remain in use for this or similar functions to ensure minimal changes in its defining characteristics.

Building 1113

No structural or architectural modifications were noted for this building, although no drawings were located to verify this. All essential exterior and interior design elements are intact and shall be preserved. The building is in good condition with only minor maintenance required. The exterior should be scraped, primed, and painted, particularly at the roof. The conduit room needs cleaned out and the conduit screened. Vegetation should be removed at the foundation perimeter (Facility Assessment Form/1113). The building is currently vacant and has only been used recently for storage. The concrete building is ideal for storage and should continue to be used for this purpose if possible. Monitoring and periodic inspection are required if the building remains vacant.

Building 1116

This building remains essentially as it was constructed, with no structural modifications noted. All essential exterior and interior design elements are intact and few repairs are currently needed. The interior needs cleaned and there is leakage from stored foodstuff that will attract insects and animals, so all exterior openings should be screened to prevent this. Vegetation should be removed at the foundation and walkway. The metal door needs scraped and painted and debris on the roof removed (Facility Assessment form/1116). There are bullet holes in most of the windows, but because of the thickness of the blast proof glass, the panes remain intact. The glass should be inspected and repaired by a specialist to ensure the cracks do not spread. The building is currently vacant, but was used for storage prior to abandonment. The concrete blockhouse is ideal for storage and should continue to be used for this purpose if possible. Monitoring and periodic inspection are required if the building remains vacant.

Building 1127

This building remains essentially as it was constructed, with no structural modifications noted. All essential exterior and interior design elements are intact except for one wooden door. A CMU wall was also added in the west room that obscures the original finish. The building is in good condition with only minor maintenance required. The metal and wood doors and exterior wood trim need scraped, primed, and painted. The roll roofing and metal drip edge should be inspected and replaced where necessary and the louvre repaired. Debris litters the exterior and should be removed to prevent further moisture, insect, and animal encroachment (Facility Assessment form/1127). The building is currently used for storage of recreational equipment and should continue to be used for this function if possible. As a storage facility, it needs to be monitored and maintained so it does not lose distinctive features or finishes due to neglect.

Building 1133

This building remains essentially as it was constructed, with no structural modifications noted. The Pritch site is the most complete missile theodolite station on HAFB, with many associated features remaining intact. Management of this property shall take into account these associated features. Building 1133 retains all essential exterior and interior design elements, although the building is falling into disrepair due to abandonment and neglect. Maintenance recommendations include: removing vegetation at the entryway; improving the grade at the principal elevation to promote positive drainage; scraping and painting wood window casings and frames; reattaching metal conduit runways; replacing broken window panes; cleaning up broken glass and debris at the interior; and installing wire mesh at the door head to improve ventilation. A barn owl nests under the retractable metal roof segments and the top floor of the building is littered with dung and bones. Isolated towers in a flat, desert environment are attractive nesting sites for birds. A LRMP project was recently completed that addressed this issue. The HAFB Natural Resources Manager should be consulted to determine how best to protect this historic property while allowing its use for roosting birds (Facility Assessment Form/1133). The building is currently vacant and because of its location will probably remain that way. Monitoring and periodic inspection are required to ensure the building does not continue to deteriorate because of neglect.

Two additional standing structures, an outhouse and generator shelter, are associated with Building 1133 and should be preserved as important contributing elements to this NRHP eligible archaeological site. Both are constructed of wood and are deteriorating due to neglect. The roll roofing should be immediately replaced on both structures, because loss of the roofs will result in complete deterioration of these abandoned facilities. The outhouse should be scraped, primed, and painted at the exterior (white paint), the gable end screens repaired, and the door repaired and fastened shut. The generator shed needs vegetation removed at its footings. A junction box with a wooden handle should be rehung at the shed post or removed for safekeeping. Associated gasoline/fuel drums should be emptied (Facility Assessment Form/1133).

<u>Building 1139</u>

This building remains essentially as it was constructed, with no structural modifications noted. All essential exterior and interior design elements are intact. It is in good condition and few repairs are currently needed. Vegetation removal is necessary at the foundation, walkways, and concrete pads. The windows and doors should be scraped, primed, and painted, and the wood at the platform deck stained. Screens should be installed at duct openings and cracks in the concrete slab floor sealed (Facility Assessment Form/1139). There are bullet holes in most of the windows, but because of the thickness of the blast proof glass, the panes remain intact. The glass should be inspected and repaired by a specialist to ensure the cracks do not spread. The building is currently used for storage of recreational equipment and should continue to be used for that purpose if possible. As a storage facility, it needs to be monitored and maintained so it does not lose distinctive features or finishes due to neglect.

<u>Building 1142</u>

This building remains essentially as it was constructed, with no structural modifications noted. All essential exterior design elements are intact—access was not gained to the interior. The facility is in good condition and the few repairs currently needed include: removing vegetation at the foundation, walkways, cable trenches, and pads; scraping, priming, and painting the metal at windows and doors; and removal of military sandbags and debris from the roof (Facility Assessment Form/1142). There are bullet holes in most of the windows, but because of the thickness of the blast proof glass, the panes remain intact. The glass should be inspected and repaired by a specialist to ensure the cracks do not spread. There is also spray painted graffiti on one exterior elevation that should be removed using a method that will not damage the concrete surface. The building is currently used for storage of commercial merchandise and retail equipment and should continue to be used for that purpose if possible. As a storage facility, it needs to be monitored and maintained so it does not lose distinctive features or finishes due to neglect.

Building 1249

This building remains essentially as it was constructed, with no structural modifications noted. It retains all essential exterior and interior design elements, although the building is heavily vandalized and in disrepair due to abandonment, neglect, and use for military exercises. The windows have been filled with concrete and the metal door strengthened with iron braces to prevent illegal entry. Keep Out signs have also been posted around the building. The Sole site is the most disturbed and modified of the HAFB missile theodolite stations. Numerous recent features have been constructed on the site, and the ground is littered with military and domestic debris. Maintenance recommendations include: providing some type of ventilation for the blocked windows; cleaning (including graffiti removal), scraping, priming, and painting interior and exterior walls and metal architectural features; repairing interior wooden features damaged by bullets; and cleaning up debris at the interior and exterior (Facility Assessment Form/1249).

If possible, the retractable aluminum roof segments should be pulled into the closed position to prevent further weathering of interior features. The door should be secured with a heavy padlock to keep intruders out, although previous attempts at this have not been successful (numerous locks have been broken off). Barn owls have nested under the retractable metal roof segments and on the platform of the second story room, and the floors are littered with dung and bones. The HAFB Natural Resources Manager should be consulted to determine how best to protect this historic property while allowing its use for roosting birds. The building is currently vacant and because of its location will probably remain that way. Monitoring and periodic inspection are required to ensure the building does not continue to deteriorate because of neglect. If military personnel continue to use the building for maneuvers, they should be briefed on its significance and provided guidelines for causing no further damage.

<u>Building 1284</u>

This building remains essentially as it was constructed, with no structural modifications noted. There have been several additions and improvements to the building during its historic period of use that contribute to its significance. Building 1284 retains all essential exterior and interior design elements, although it is falling into disrepair due to abandonment and neglect. Maintenance recommendations include: removing of vegetation at the foundation; scraping, priming, and painting all concrete, concrete masonry, and metal surface and features; repairing expansion joints and concrete soffit; repairing and waterproofing the roof; closing pipe inlets; and cleaning up debris at the interior (Facility Assessment Form/1284). Floor and ceiling tiles, and possibly roof materials, contain asbestos and would have to be removed before the building can be used. The building has been used for communication purposes for missile testing and HSTT projects and is ideal for adaptive reuse. It is a large building with numerous work rooms, bathrooms, and storage space and is located on the prominent Tularosa Peak. It is currently vacant, but should be rehabilitated and used before it falls into major disrepair due to abandonment and neglect. Renovation of the facility would be more cost effective than demolishing the current building and constructing a new one.

Building 1440

This building remains essentially as it was constructed, with no structural modifications noted. All essential exterior and interior design elements are intact. There have been several additions and improvements to the building during its historic period of use that contribute to its significance. It is in good condition and few repairs are currently needed. Vegetation removal is necessary within the large fenced area where the building is located. The exterior concrete, metal door, and metal window frames need scraped, primed, and painted. There is concrete damage at the north elevation window in need of repair. The roof should be inspected and repaired as needed (Facility Assessment Form/1440). There is evidence of rodent and insect encroachment at the interior. Gaps and holes at the window sills, conduit runs, and electrical boxes should be caulked or filled to prevent this. The building is currently used for storage of environmental samples and equipment and should continue to be used for that purpose if possible. As a storage facility, it needs to be monitored and maintained so it does not lose distinctive features or finishes due to neglect.

Building 1442

This building remains essentially as it was constructed. The basic structure remains intact, but large exhaust pipes, interior bracing and insulation, and equipment have been removed. Its condition is moderate to fair and it has been heavily vandalized. All of the door and bay openings are fenced to keep out intruders. A number of repairs are currently needed to preserve its physical and visual integrity. Minor maintenance recommendations include: removing vegetation from the foundation slab, back filling large animal burrows and repairing damaged asphalt at the main bay opening, and removing trash and debris from the exterior and interior of the facility. The remaining insulation batts in the launch bays add to the historic integrity, but they appear to retain moisture and are accelerating rust at the exterior shell. Their removal should be considered (Facility Assessment Form/1442). Much of the extensive graffiti was painted over in 1997 using silver paint on the corrugated metal and concrete, and rust colored paint on the iron features. This approach covered, but did not solve, the problem. The removal of graffiti will require an extensive effort but should be considered to improve the appearance of the facility. In addition, graffiti seems to invite more graffiti, although the author has noted no new additions for years. The building is currently vacant. Because of its specialized construction, large open bays, and remote location, it will probably remain that way. It has been used for storage of large transformers, and would be ideal for vehicle or construction material storage. Monitoring and periodic inspection are required if the building remains vacant.

Incinerator

This small brick incinerator is thought to remain as it was constructed, although no drawings or records were located to verify this. The only modification appears to be to an opening at the east façade that has been filled in. The structure is in good condition and only the removal of vegetation around its perimeter is recommended (Facility Assessment Form/Incinerator). It is unknown if the incinerator was used for any other purposes, and its function precludes its use for future mission related activities. It will remain abandoned and should be monitored to ensure it retains integrity.

JB-2 Ramp

This earthen ramp remains essentially as it was constructed, with no structural modifications noted. Most of the wooden ties and metal rails associated with the launch track have been removed and several features have been added. These additions and improvements occurred during the structure's historic period of use and contribute to its significance. The ramp is in good condition, although there is extensive erosion to the berm around a concrete feature cut into the northeast end. The area around the concrete feature should be stabilized immediately to preclude further lost of the berm. Trash has also been deposited in the concrete loading pit and should be removed. The ramp is currently abandoned. It has only been used for missile testing, and its function precludes its use for future mission related activities. It will remain abandoned and should be monitored to ensure it retains its integrity.

Jeep Target

This earthen berm is thought to remain as it was constructed, although no drawings or records were located to verify this. The structure is in good condition. The berm and associated concrete jeep track have been damaged from recent military use and the rails removed from the track, but these disturbances have not obscured original materials or workmanship. The berm is eroding around original and new breaches and new foxholes and bunkers. This erosion is in need of immediate stabilization. The Jeep Target is currently used for military training and requires no modifications. Military personnel using the locale should be briefed on its significance, and restricted from excavating new breaches, bunkers, or foxholes into the berm. The structure can continue to be used as a training facility, as long as this function does not impact its integrity. The structure should be visited periodically to monitor the erosion and ensure there are no new disturbances.

Test Stand

This concrete structure is thought to remain as it was constructed, although no drawings or records were located to verify this. Associated wooden and metal features have deteriorated or been removed and an opening at the end of the structure has been covered with an iron plate. The structure is in good condition, although the interior deluge tank below a manhole is filled with garbage that should be removed. It is unknown if the Test Stand was used for any other purposes, and its function precludes its use for future mission related activities. It will remain abandoned and should be monitored to ensure it retains integrity.

CHAPTER 8

SUMMARY AND CONCLUSIONS

This project was designed to evaluate all WW II and late 1940s facilities and a number of 1950s and 1960s properties considered to have a high potential for significance. Thirty-four facilities constructed between 1942 and 1962, including 18 from WW II and 16 from the early Cold War, were documented and assessed using HABS/HAER Level IV recording methods and the HAFB-specific Facility Assessment form. At the conclusion of the fieldwork, NRHP eligibility was recommended for the properties; 17 (14 Cold War and three WW II) were considered eligible and 17 (15 WW II and two Cold War) were ineligible. Including the work completed by Fulton and Cooper (1996), 107 buildings and structures have now been evaluated at a sufficient level to fulfill Section 110 requirements. These include all non-housing facilities constructed from 1942 through 1955, as well as a few constructed up to 1962. Groups of housing units, such as Wherry and Capehart housing, were not included in these assessments because of the large number of such facilities on HAFB and their probable lack of significance.

At the beginning of this project, only 18 facilities of the hundreds constructed during WW II remained intact. All of these facilities were located in the Cantonment, Munitions Storage, and Jeep Target areas, which have been continuously used for the past 50 years. In addition, the majority of the buildings were originally constructed of wood as temporary or semipermanent to meet the immediate needs of the war, and were never meant to be in use 50 years later. As the base mission changed, some facilities were demolished to make way for more permanent, modern buildings, and other facilities were modified to fulfill a variety of new functions. Demolition of temporary structures began immediately after the war ended when many housing units were removed. Destruction of facilities continues to the present time as old buildings are removed to make way for new facilities; three buildings (Buildings 200, 599, and 754) were demolished immediately after they were assessed and three buildings are slated for demolition in 1998 (Buildings 107, 289, and 291). Those buildings that escaped destruction have been heavily modified to make them useable for new functions and to last beyond their five to fifteen year life span (temporary and semipermanent buildings, respectively). The continued use of the Cantonment Area, changes in the base mission, and general attrition have taken their toll on the WW II facilities. Today, HAFB retains no feeling from the WW II era when Heavy and Very Heavy bomber aircrews trained for combat assignments and B-17s, B-24s, and B-29s filled the skies above the Tularosa Basin.

Twelve of the 18 WW II facilities retain little, if any, of their original appearance. These buildings were generally constructed of wood and were of a generic single story, gable roof style that could easily be modified for a variety of functions. Most had nonspecialized functions such as administrative buildings or classrooms. Six facilities remain relatively intact, possibly because of their specialized functions or construction style. Two maintenance hangars, Buildings 301 and 1079, and the Jeep Target are recommended as eligible for the NRHP because they are thought to exhibit unique design and construction features and are the best remaining examples of WW II architecture on the base. They have been used for their intended purposes as aircraft hangars and a training facility since their construction, so modifications have been limited. It is unknown if better examples of these property types exist elsewhere in the U.S., and further research is suggested to determine if the HAFB facilities are significant at a national level. Buildings 289, 1236, and 1237 are hazardous material and munitions storage facilities that have also been used for their original functions since their construction. Although retaining integrity, these buildings are not considered significant and are recommended as ineligible for the NRHP. Hollow clay tile storage facilities were common in the WW II era, and these buildings have been completely documented.

The three WW II facilities recommended as eligible for the NRHP provide a good cross section of the base's role during the war. The two hangars sheltered the bombers flown to train aircrews in flight methods and strategy (i.e., formation flying), navigation, bombing, and aerial gunnery. The Jeep Target is the only training range left on the base, a reminder of aircrews practicing the use of machine guns and turrets. The preservation of Buildings 1236 and 1237, although ineligible, would expand this cross section by preserving facilities that once housed munitions used by the aircrews for practice gunnery and, perhaps, bombing. The preservation of the three eligible facilities, and perhaps two of the ineligible properties, will leave HAFB with a legacy of WW II and the airmen who lived, trained, and sometimes sacrificed their lives preparing to fight for their country.

The 16 Cold War facilities are only a few of the hundreds still in use on HAFB, but they are perhaps the most representative of HAFB's important missile testing role during that era. In contrast to those from WW II, all but one of the Cold War facilities are located north of the Cantonment Area in the remote Supplemental Area, which has experienced limited or no major mission related use since the end of the 1950s. The buildings were built to be permanent and were mainly constructed of concrete or CMUs for specific test programs or functions. As the missile test programs ended at HAFB, the facilities were abandoned and their locations in remote areas made reuse impractical. With few exceptions, the later flying missions of HAFB did not require use of lands outside the Cantonment Area. For that reason the buildings and structures received very little modification, and most have been used only for storage over the past 30 or 40 years. Many of the facilities are located in two Cold War complexes which retain their feeling of early Cold War test programs at HAFB.

All of the Cold War facilities retain their original design characteristics and integrity and 14 are considered eligible for the NRHP. The two ineligible buildings, while not considered exceptional, may warrant preservation: Building 322, a bathhouse in the Cantonment Area, and Building 1285, a storage building on Tularosa Peak. The bathhouse has a plaque on its primary elevation dedicating it to the men who lost their lives in WW II. Nothing is known about the origin of the plaque, but it may be considered a memorial, making the facility significant at a local level. Building 1285 was associated with the Building 1284 instrumentation facility and may be considered a contributing element. Further research and documentation of the features on Tularosa Peak are warranted to determine if this building is a significant part of the communication/instrumentation site.

Of the 14 eligible facilities, nine are considered exceptional and five are recommended eligible because of their association with the MTSA and Able 51 missile complexes. Eight facilities are associated with the NRHP eligible MTSA, seven within and one outside the site boundaries. The three observation shelters (Buildings 1116, 1139, and 1142) and the JB-2 Ramp exhibit distinctive and unique construction characteristics and are exceptional properties. Further research is recommended to determine whether the Test Stand, the Incinerator, and Building 1113 also fit into that category. Building 1127, a missile assembly building, is not exceptional as an individual property but was directly associated with use of the JB-2 Ramp and Building 1116. Two buildings are located at the NRHP eligible Able 51/ZEL site. Building 1442 exhibits unique design characteristics and is exceptional. Building 1440 is not exceptional but was directly associated with the launch building. The remaining four buildings are isolated instrumentation stations considered exceptional because they exhibit distinctive and unique design elements. Building 1284 is on Tularosa Peak and the three missile theodolite towers (Buildings 900 [Mart site], 1133 [Pritch site], and 1249 [Sole site]) are located in isolation within the Supplemental Area. Further research may indicate the entire instrumentation/communication complex on Tularosa Peak, and not just Building 1284, is eligible

These 14 eligible Cold War facilities are the most significant and unique properties of that era on HAFB. Immediately following WW II, AAAF was one of many bases scheduled for closure as the military began postwar downsizing. The large tracts of uninhabited land provided by AAAF, ABGR, and WSPG and the ideal southern New Mexico climate prompted the transfer of missile test programs from Wendover AAF, Utah, in 1947 and ensured HAFB's role in history. A wide variety of test vehicles were developed and tested at HAFB as the U.S. strove to maintain its military superiority over the U.S.S.R. New and improved communication and instrumentation systems were developed, and a vast network of stations established to document and track the various test vehicles. These early test programs contributed to current U.S. weapons technology and the quest for space exploration. The Cold War facilities represent a legacy of that contribution.

CONCLUSIONS

In 1995, Secretary of the Air Force Sheila Widnall stated that historic buildings on USAF bases reflect the history of our country and the Air Force, and it is important that we preserve them (Wagner 1996:back cover). WW II facilities are 50 years old and are managed as cultural properties. For that reason, many buildings and structures from that era have been documented and evaluated. The DoD only recently developed an initiative focusing on the preservation of buildings, structures, and objects from the Cold War. In response to that initiative, the USAF prepared the *Interim Guidance for the Treatment of Cold War Historic Properties*. These efforts are the first step in preserving the important Cold War properties on DoD facilities and illustrate the proactive stance of the DoD in the management of these relatively young, but very important, cultural resources.

The architectural assessments conducted at HAFB reflect this base's efforts to identify, document, evaluate, and preserve WW II and Cold War properties. As illustrated by the current project, most WW II facilities have been removed from the base; those that remain have been evaluated and only three retain significance. The assessment of Cold War facilities before they reach the 50 year mark presents the opportunity to ensure that the same fate does not befall the many significant properties from that era. Twenty-seven Cold War properties have been recommended as eligible to the NRHP during the two base-wide architectural assessments (Fulton and Cooper 1996 and the current project). The properties are related to HAFB's five most important research and development complexes/programs directly associated with the Cold War: the High Speed Test Track, Aeromedical Research Laboratory (including the Daisy Track), Missile Test Stands Area, Able 51/ZEL site, and communications/instrumentation sites (including the Tularosa Peak instrumentation station and the missile theodolite towers). The two assessment projects, though, only include facilities constructed through 1955, with a limited few into the early 1960s, leaving many more buildings and structures directly and indirectly associated with the Cold War that need to be evaluated. A determination of which of the remaining facilities should be evaluated and the subsequent architectural assessments of those properties is a priority for the cultural resources program at HAFB. As Fulton and Cooper (1996:417) stressed, "The buildings, structures, objects, and Cold War documents conserved today will provide the grist tomorrow for research into this unique and often perilous phase of world history."

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APPENDIX A

PREVIOUSLY INVESTIGATED FACILITIES AND NATIONAL REGISTER RECOMMENDATIONS

APPENDIX B

FACILITY ASSESSMENT FORM EXAMPLE

APPENDIX C

FACILITY LOCATION MAPS

HAFB BUILDING LOCATION MAPS

Those portions of HAFB including numbered Real Property are demarcated on a series of 12 maps on file at the 49 CES/CECNC (drafting element) (Tabs C-1 through C-12). The seven maps containing the facilities included in this report are reproduced here. The facility and corresponding HAFB map number are listed below. The location of each map within HAFB is shown in the upper right corner of the key.

Building #	Map # (x of 12)	Building #	Map # (x of 12)
40	3	1113	6
71	3	1116	6
96	3	1127	6
107	3	1133	6
200	3	1139	4
205	3	1142	4
218	3	1236	5
289	3	1237	5
291	3	1249	9
300	3	1284	12
301	3	1285	12
302	3	1440	4
322	3	1442	4
599	3	Incinerator	5
754	1	JB-2 Ramp	6
900	4	Jeep Track	4
1079	3	Test Stand	4

APPENDIX D

CONSTRUCTION TYPES

I. Wood Frame

Building	Property Type	Date of Completion
40	Training Facilities	ca. 1943
71	Operations and Support	ca. 1943
96	Operations and Support	ca. 1943
107	Training Facilities	ca. 1943
200	Operations and Support	ca. 1943
205	Operations and Support	ca. 1943
218	Operations and Support	ca. 1943
301	Combat Weapons and Support	ca. 1944
302	Operations and Support	ca. 1942
599	Training Facilities	ca. 1943
754	Operations and Support	ca. 1943
1079	Combat Weapons and Support	ca. 1943

II. Concrete Frame with CMU Infill Walls Supporting Reinforced Concrete Roof Slab

Building	Property Type	Date of Completion
322	Operations and Support	ca. 1949
1284	Material Development Facilities	ca. 1948

III. Concrete Frame with Reinforced Concrete Walls and Roof Slab

Building	Property Type	Date of Completion
1113	Material Development Facilities	ca. 1949
1440	Material Development Facilities	ca. 1962

IV. Monolithic Concrete

Building	Property Type	Date of Completion
900	Material Development Facilities	ca. 1954
1116	Material Development Facilities	ca. 1947
1133	Material Development Facilities	ca. 1954
1139	Material Development Facilities	ca. 1947
1142	Material Development Facilities	ca. 1950
1249	Material Development Facilities	ca. 1954

V. Steel Column and Truss Frame

Building	Property Type	Date of Completion

291	Combat Weapons and Support	ca. 1943
300	Combat Weapons and Support	ca. 1943

VI. Steel Bent Unit Frame

Building	Property Type	Date of Completion
1442	Material Development Facilities	ca. 1959

VII. Structural Clay Tile Walls/Wood roof

Building	Property Type	Date of Completion
289	Combat Weapons and Support	ca. 1943
1236	Combat Weapons and Support	ca. 1943
1237	Combat Weapons and Support	ca. 1943

VIII. Miscellaneous

Building	Property Type	Date of Completion
Incinerator (Brick/Steel hood)		Material
Development Facilities		ca. 1950
JB-2 Ramp (Earthen ramp)	Material Development Facilities	ca. 1947
Test Stand (Concrete)	Material Development Facilities	ca. 1955
1127 (Concrete and wood frame)		Material
Development Facilities		ca. 1955
1285 (Metal Shed)	Material Development Facilities	ca. 1950
Jeep Track (Earthen berm)	Training Facilities	ca. 1943

ABOUT THE AUTHORS

Martyn D. Tagg was born at Fairchild AFB, Washington, and grew up on Air Force bases throughout the continental United States and Europe. He has a B.A. degree in Anthropology from the University of Arizona in Tucson. Over the past 20 years, he has conducted archaeological projects for private and government agencies in Arizona, California, Mississippi, New Mexico, and South Carolina. Mr. Tagg created the Holloman AFB cultural resources program in 1992 and managed it through 1997. He received numerous awards for his work at the base including the ACC Cultural Resources Award for Individual Excellence (1993 and 1996), ACC Natural/Cultural Resources Management Award (1994), ACC Cultural Resources Management Award (1997), and USAF Cultural Resources Management Award for Individual Excellence (1993). Mr. Tagg has written numerous professional publications and articles. The most recent include *"We Develop Missiles, Not Air"* in the HAFB Publication series and Early Cultigens at Fresnal Shelter, East-central New Mexico in *American Antiquity*. He is currently the Cultural Resources Manager for Headquarters Air Force Materiel Command at Wright-Patterson AFB, Ohio.

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