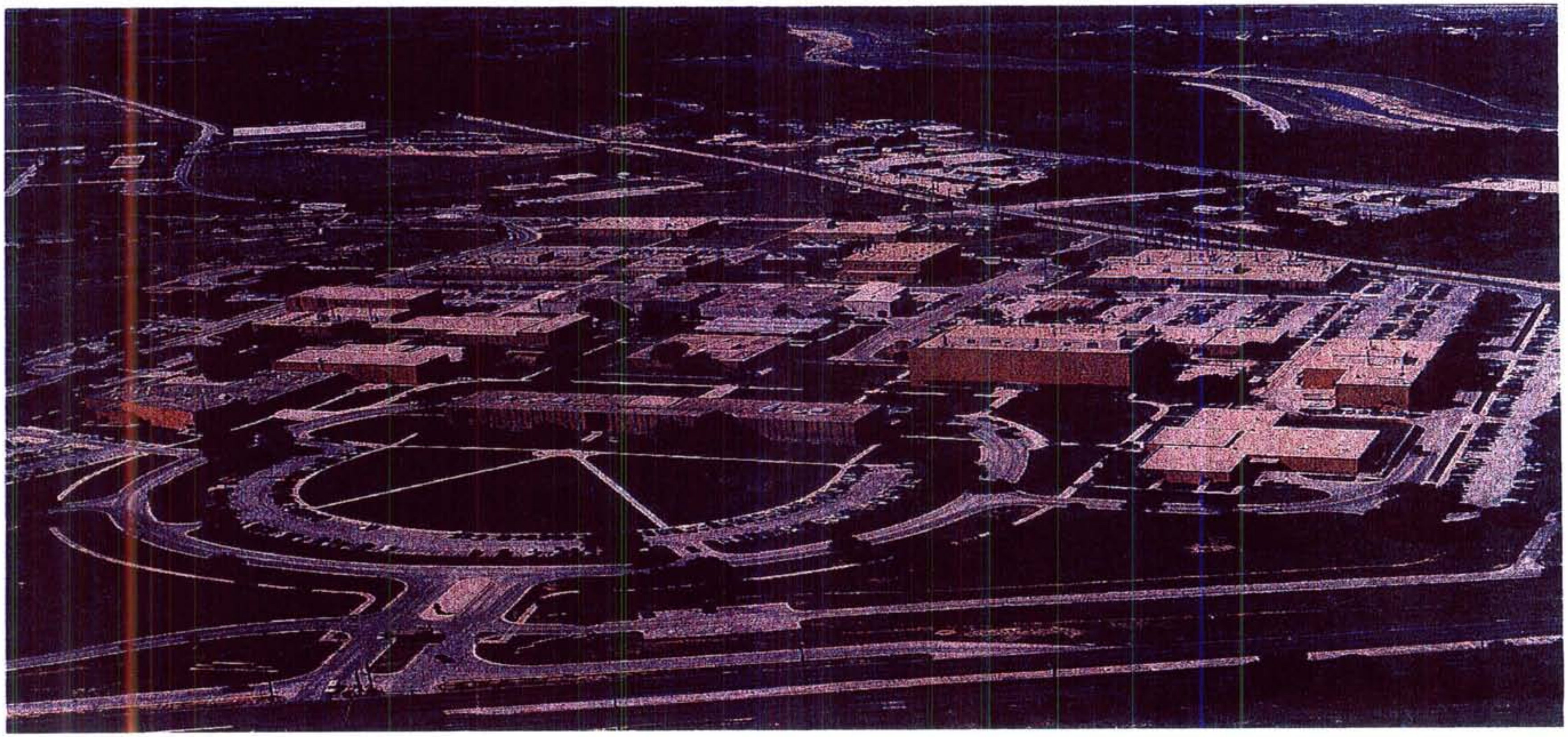
DCN 434

BROOKS AIR FORCE BASE



BROOKS AFB

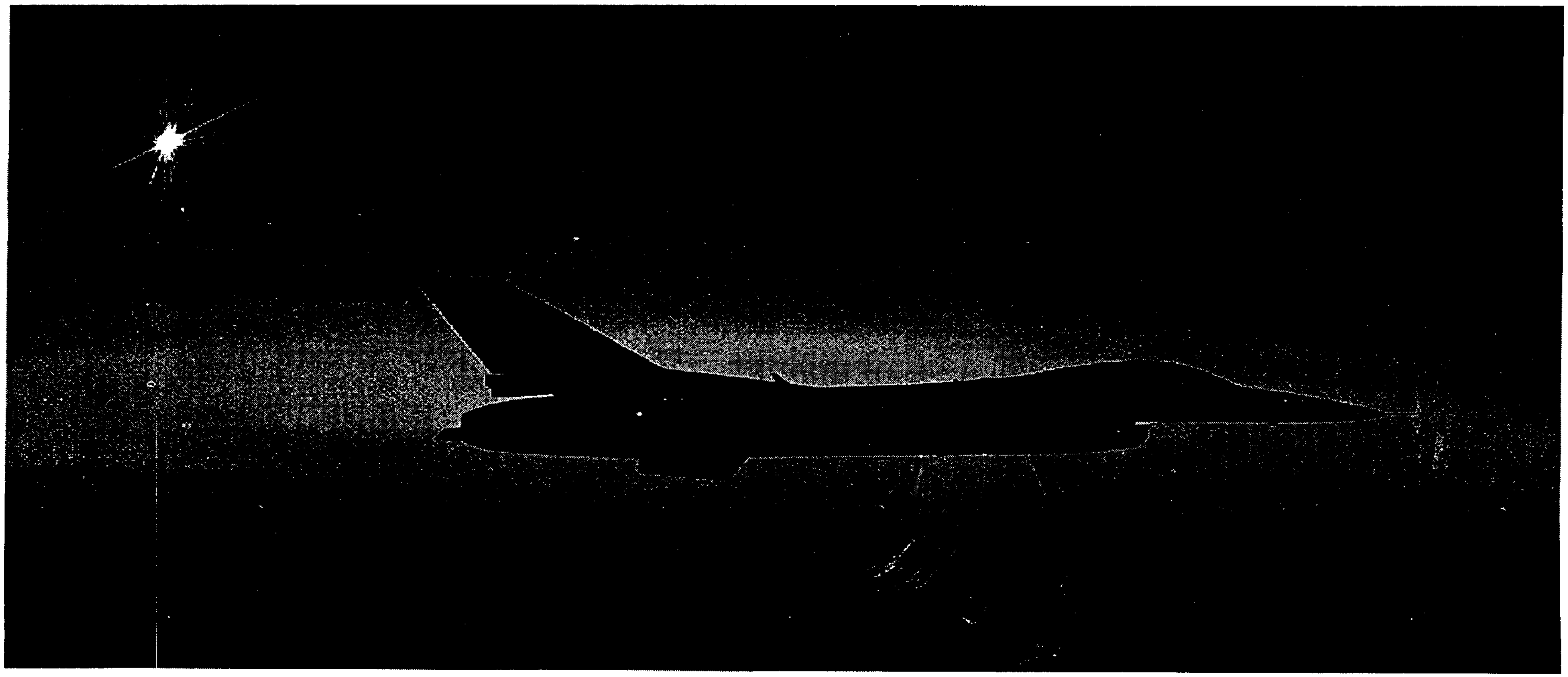
OVERVIEW

- MISSION
- THE PROPOSALS
  - DoD PROPOSAL
  - ALTERNATIVE
  - COMPARISONS
- SUMMARY

BROOKS AFB

THE HUMAN SYSTEMS CENTER

THE HUMAN IS THE HEART OF AEROSPACE SYSTEMS AND OPERATIONS



BROOKS AFB

ARMSTRONG LABORATORY

HUMAN SYSTEMS CENTER

AF CENTER FOR ENVIRONMENTAL EXCELLENCE

HUMAN SYSTEMS PROGRAM OFFICE

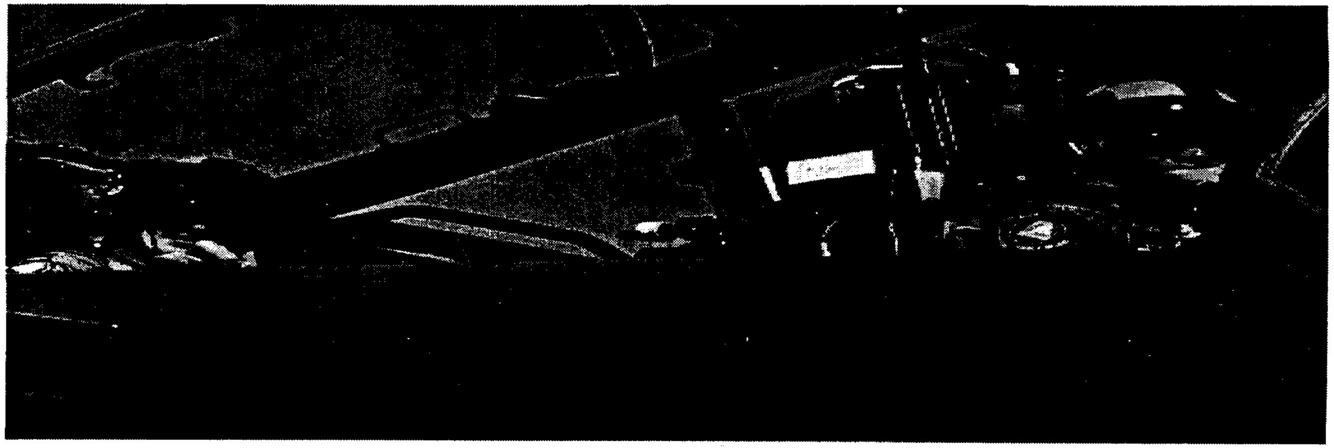
TRANSFORMING POTENTIAL TO REALITY

Volanti Subvenimus

BROOKS AFB SNAPSHOT

- 3,619 People Managing $608 Million Annually
- 2,215 Degrees Held
  - Scientists
  - Researchers
  - Medical Doctors
  - Research Technicians
- 400 Acquisition Professionals
- 128 Education/Training Instructors
  - 61 Aerospace Medicine Courses Graduating 4,678 Students
  - 8 System Acquisition Courses Graduating 1,385 Students

BROOKS AFB



THE WARFIGHTER

AIR FORCE COMBAT COMMAND

AIR FORCE MOBILITY COMMAND

AIR FORCE SPACE COMMAND

AIR FORCE SPECIAL OPERATIONS COMMAND

PACAF

USAFE

DELIVER KNOWLEDGE & SKILLS

SUPPORT OPERATIONAL SYSTEMS

DELIVER HUMAN SYSTEMS

SUPPORT WEAPONS SYSTEMS DEVELOPMENT

DELIVER HUMAN-CENTERED SCIENCE & TECHNOLOGY

BROOKS AFB

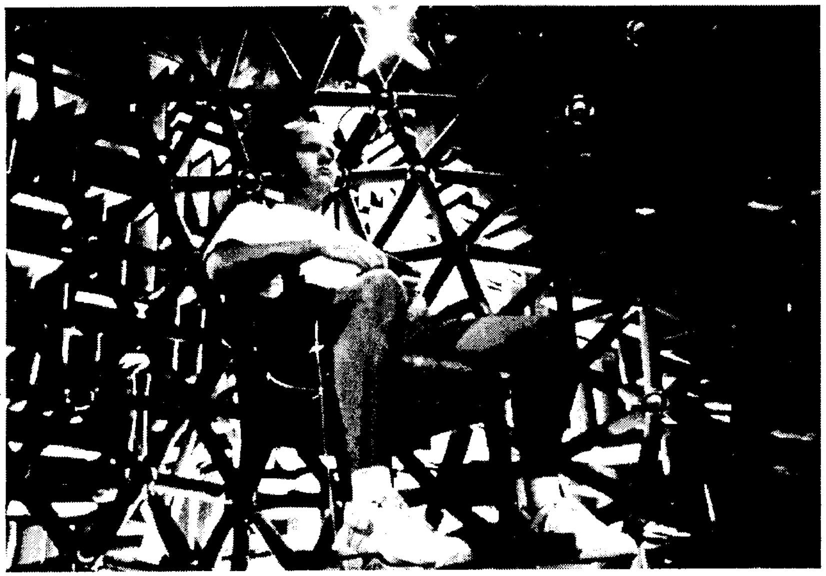
HUMAN SYSTEMS CENTER
Products and Progress

MISSIONS & PRODUCTS

- **CREW SYSTEMS**
- **HUMAN RESOURCES**
- **AEROSPACE MEDICINE**
- **OCCUPATIONAL & ENVIRONMENTAL HEALTH**
- **ENVIRONICS**

BROOKS AFB

Crew Systems

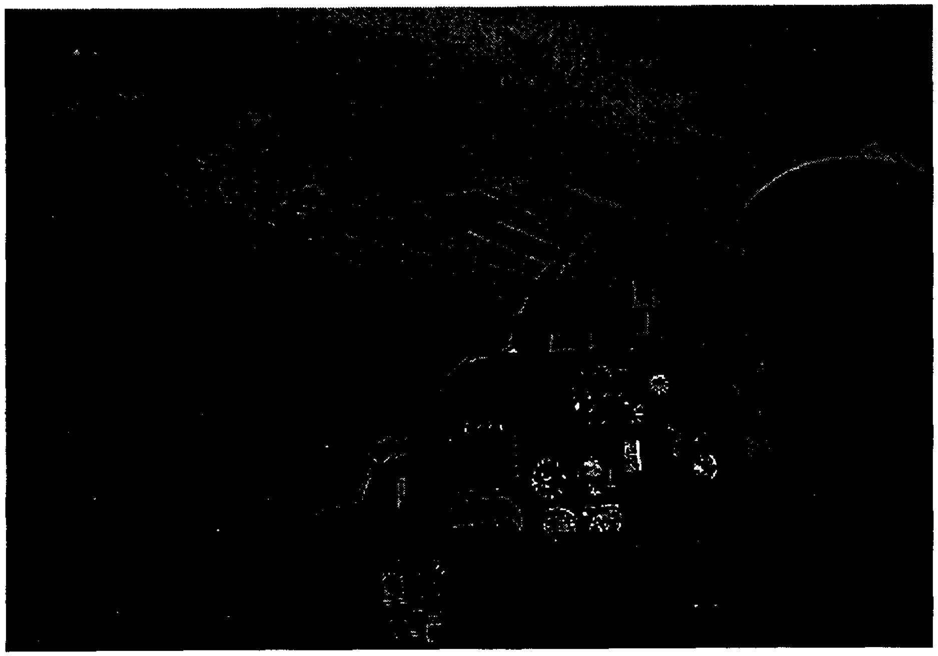


This Human Systems Center product area accomplishes research and develops, fields, and supports technology and systems to optimize human combat performance and survivability to ensure weapons systems configurations are compatible with human operator requirements.

- **NUCLEAR - BIOLOGICAL - CHEMICAL DEFENSE**
- **LIFE SUPPORT**
- **CREW INTERFACE TECHNOLOGY**
- **OPERATIONAL PERFORMANCE**
- **HUMAN - CENTERED DESIGN**

BROOKS AFB

Human Resources

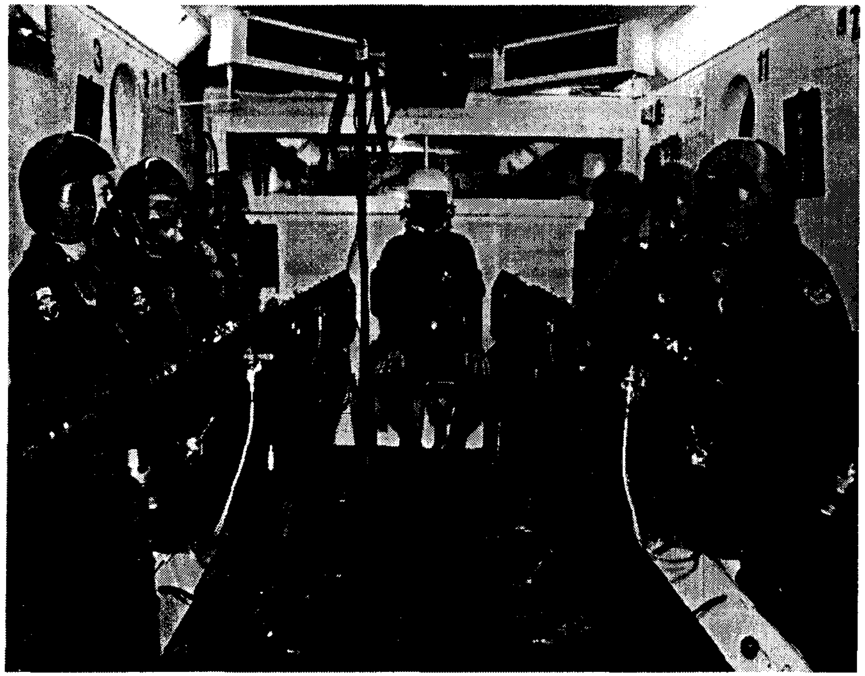


This Human Systems Center product area accomplishes research and develops, fields, and supports unique Manpower, Personnel, and Training technology and systems.

- **FORCE MANAGEMENT**
- **AIRCREW TRAINING**
- **TRAINING SYSTEMS**
- **LOGISTICS SUPPORT**

BROOKS AFB

Aerospace Medicine

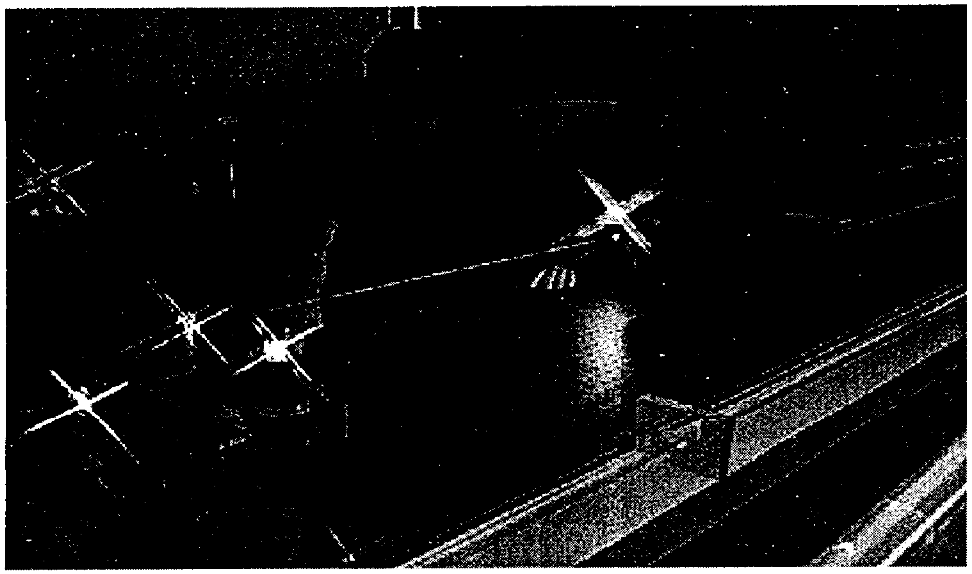


This Human Systems Center product area provides research and specialized operational support in aeromedical consultation, epidemiolgy, drug testing, and hyperbaric medicine, as well as development, fielding, and support of aeromedical systems and equipment.

- **AEROMEDICAL CASUALTY CARE**
- **OPERATIONAL APPLICATIONS**
- **AEROMEDICAL EDUCATION**

BROOKS AFB

Occupational and Environmental Health



This Human Systems Center product area assesses risks to personnel from hazardous materials, noise, electromagnetic radiation, and occupational processes in USAF operations. The work combines human-centered research and development in these emphasis areas with broad field consultation responsibilities to measure and reduce occupational illness and environmental hazards.

- **OCCUPATIONAL HEALTH**
- **HAZARDOUS MATERIALS**
- **RADIATION**

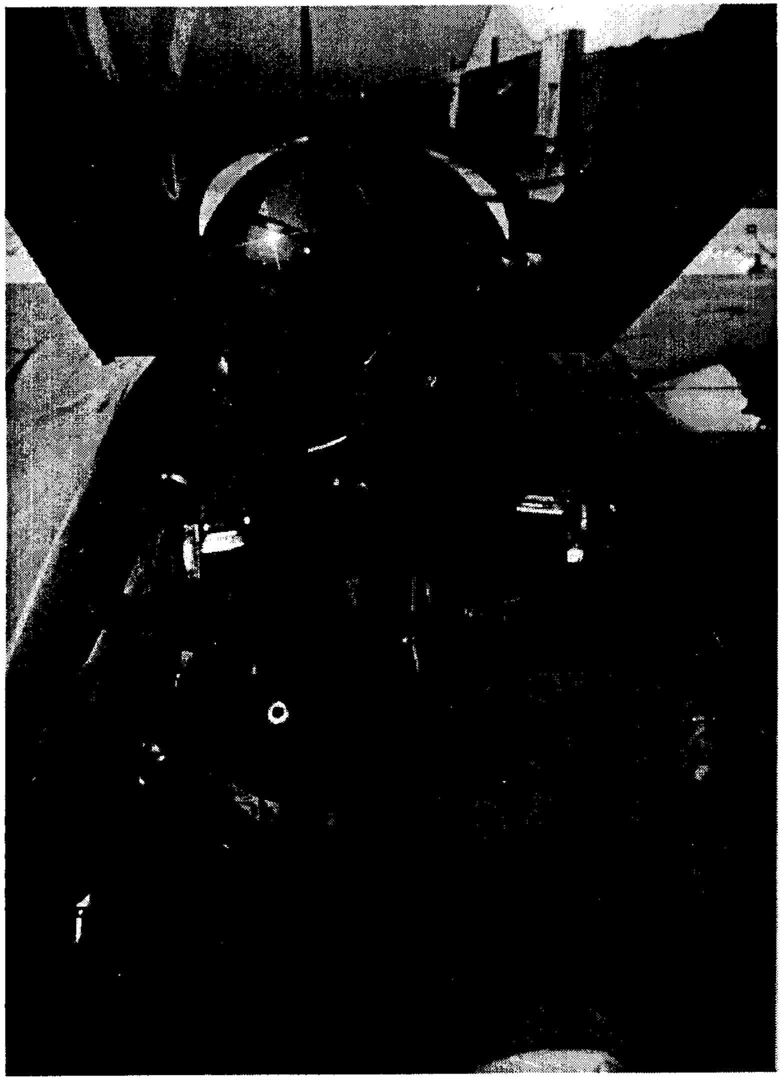
BROOKS AFB

Environics and Environment Clean-up

This Human Systems Center product area provides environmental quality technology that supports the Air Force mission by reducing the cost of cleaning up past waste sites while assuring, through compliance, the completion of critical wartime and peacetime missions. The Air Force Center for Environmental Excellence applies these leading edge technologies to environmental clean-up projects.

- **BIODEGRADATION**
- **BIODEGRADABLE SOLVENTS AND CLEANERS**
- **ROCKET PROPELLANT DISPOSAL**

BROOKS AFB



THE AIR FORCE HUMAN SYSTEMS CENTER

- ENHANCE WARFIGHTER'S COMBAT CAPABILITY
- ADVOCATE FOR THE HUMAN
  - DESIGN
  - DEPLOYMENT
  - OPERATIONS

BROOKS AFB

MISSIONS

- HUMAN SYSTEMS CENTER
- HUMAN SYSTEMS PROGRAM OFFICE
- ARMSTRONG LABORATORY
- SCHOOL OF AEROSPACE MEDICINE
- CENTER FOR ENVIRONMENTAL EXCELLENCE

AN INTEGRATED HUMAN SYSTEMS CENTER

BROOKS AFB

THE BOTTOM LINE

- THE BROOKS MISSIONS WILL BE RETAINED
- THEY WILL BE CONDUCTED SOMEWHERE
- MORE COST-EFFECTIVE IN SAN ANTONIO

SAN ANTONIO SYNERGY

UNIQUE MILITARY HUMAN SYSTEMS COMMUNITY

- HUMAN SYSTEMS CENTER
- ARMSTRONG LAB
- USAF SCHOOL OF AEROSPACE MEDICINE
- AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
- HUMAN SYSTEMS PROGRAM OFFICE
- AIR EDUCATION AND TRAINING COMMAND
- AIR FORCE MILITARY PERSONNEL CENTER
- LACKLAND AFB
- KELLY AFB

SAN ANTONIO SYNERGY

ONE-OF-A-KIND BIOMEDICAL COMMUNITY

- UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER
- TEXAS RESEARCH AND TECHNOLOGY FOUNDATION
- SOUTHWEST RESEARCH INSTITUTE
- SOUTHWEST FOUNDATION FOR BIOMEDICAL RESEARCH
- WILFORD HALL MEDICAL CENTER
- BROOKE ARMY MEDICAL CENTER
- UNIVERSITY OF TEXAS AT SAN ANTONIO
- AIR EDUCATION AND TRAINING COMMAND

BROOKS AFB

THE PROPOSALS

BROOKS AFB

COMPARISONS

	DoD Proposal	Alternative
• SCENARIO	RELOCATE	CANTONMENT
• BROOKS AFB	CLOSE	CLOSE
• PEOPLE		
•Eliminate	391	391
•Relocate	3,228	518
• ONE TIME COST	$ 185 Million	$ 11 Million
• 20 YEAR NET PRESENT VALUE	$ 142 Million	$ 301 Million
• RETURN ON INVESTMENT	7 Years	Immediate

BROOKS AFB
DoD PROPOSAL

- CLOSE BROOKS AFB
- RELOCATE TO WRIGHT PATTERSON AFB
  - * Human Systems Center
  - * Armstrong Laboratory
  - * School of Aerospace Medicine
- RELOCATE TO TYNDALL AFB
  - * Air Force Center for Environmental Excellence
- RELOCATE TO KELLY AFB
  - * 68th Intelligence Squadron
- RELOCATE TO LACKLAND
  - * 710th Intelligence Flight
  - * Hyperbaric Chamber Operation
- RELOCATE TO BASE X
  - * Air Force Drug Test Laboratory

• MOVES		3,228 People
• ONE-TIME COSTS		$185 Million
• Milcon	$ 103 M	
• Movement	47 M	
• Personnel	6 M	
• Overhead	5 M	
• Other	2 M	
• One-Time Unique	21 M	
• NET PRESENT VALUE		$ 142 Million

BROOKS AFB

AN ALTERNATIVE - *CANTONMENT*

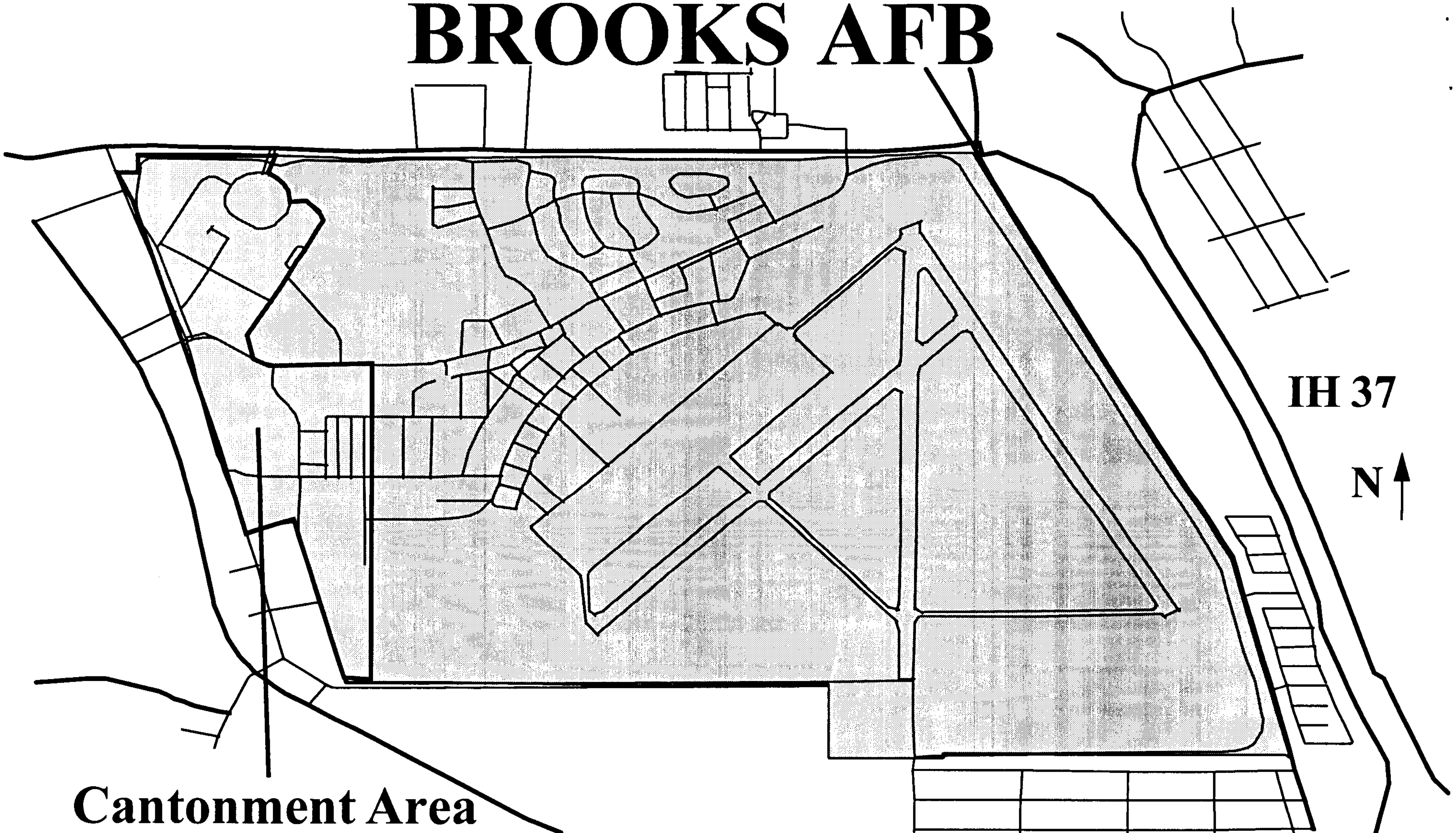
- CLOSE BROOKS AFB

- RETAIN MISSIONS IN CANTONMENT IN SAN ANTONIO
  - * Human Systems Center
  - * Human Systems Program Office
  - * Armstrong Laboratory
  - * School of Aerospace Medicine
  - * Center for Environmental Excellence

- RELOCATE TO KELLY AFB & LACKLAND AFB
  - * 68th Intelligence Squadron
  - * 710th Intelligence Flight

- BOS & RPM PROVIDED BY KELLY AFB OR LACKLAND AFB

BROOKS AFB



BROOKS AFB

THE RESULTS

- CLOSE BROOKS AFB

- PEOPLE/JOBS
  - * Eliminate — 391
  - * Relocate — 518 (Across Town)

- ONE TIME COST — $ 11 Million
  - * MILCON $ 6 Million

- 20 YEAR NET PRESENT VALUE — $ 301 Million

- RETURN ON INVESTMENT — Immediate

BROOKS AFB

COMPARISONS

	DoD Proposal	Cantonment
• SCENARIO	RELOCATE	CANTONMENT
• BROOKS AFB	CLOSE	CLOSE
• PEOPLE		
•Eliminate	391	391
•Relocate	3,228	518
• ONE TIME COST	$ 185 Million	$ 11 Million
• 20 YEAR NET PRESENT VALUE	$ 142 Million	$ 301 Million
• RETURN ON INVESTMENT	7 Years	Immediate

THE CASE FOR CANTONMENT

- BROOKS MISSIONS AND SCIENTISTS ARE ESSENTIAL
  - THESE MISSIONS WILL BE CONDUCTED SOMEWHERE

- SAN ANTONIO IS THE RIGHT PLACE
  - PRESERVES THE SYNERGIES
  - MORE COST EFFECTIVE

- THERE ARE TWO OPTIONS

THE CASE FOR CANTONMENT

OPTIONS

- DoD PROPOSAL
  - CLOSE BROOKS AFB
  - MOVE MISSIONS & SCIENTISTS
- CANTONMENT
  - CLOSE BROOKS AFB
  - KEEP MISSIONS & SCIENTISTS

COST-BENEFIT ANALYSIS

DoD Proposal:

- COSTS: $185 MILLION
- SAVES: $142 MILLION
- RISKS LOSING SCIENTISTS
- LOSES SYNERGIES

Cantonment:

- COSTS: $11 MILLION
- SAVES: $301 MILLION
- KEEPS SCIENTISTS
- RETAINS SYNERGIES

The Secretary of Energy
Washington, DC 20585

April 17, 1995

93
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The Honorable Alan J. Dixon
Chairman, Defense Base Closure
and Realignment Commission
1700 North Moore Street
Arlington, Virginia 22209

Dear Mr. Dixon:

The Department of Energy and the Air Force have long enjoyed a mutually beneficial relationship at Kirtland Air Force Base. However, in February, the Department of Defense announced that Kirtland was identified as a candidate military installation for a major realignment. Prior to the Department of Defense decision to realign Kirtland, the Department of Energy was not contacted for input regarding the impact of such a decision on our activities and operations.

The Department of Energy and Sandia National Laboratories, as major tenants on the Kirtland Air Force Base, are dependent on the Air Force to provide safety, security, and infrastructure support on the Kirtland Air Force Base. These services include security, fire protection, and emergency operations as well as maintenance and operations of roads, utilities, traffic control, and grounds maintenance. The organizations that currently provide those services are proposed to be either relocated to other bases or to be dissolved. This will result in the Department of Energy and Sandia National Laboratories having to assume many of these responsibilities to continue our program. Since that announcement, we have been analyzing the cost and operational impacts of the potential realignment on the Department's operations at the base.

If the proposed realignment is approved, it appears that the Department of Energy and the Sandia National Laboratories would need to establish an operations, safety, and security zone, which comprises a large percentage of the land currently encompassed by the base. With this responsibility would come a requirement for additional funding. We estimate that it would cost the Department of Energy an additional 65 million dollars of one-time costs to acquire or carry through with the Air Force planned capability enhancements needed to continue the current Department of Energy operation on Kirtland Air Force Base. In addition, about 30 million dollars would be required on an annual basis to maintain and continue these operations. We estimate that the cost to the Department of Energy over the next 20 years, expressed in net present value terms, could be about 440 million dollars. While we are continuing to review our estimates, we are confident these are generally correct. These estimates do not include the capabilities necessary to support the other remaining tenants on the base. We believe the other tenants, both large and small, would be impacted by the Kirtland realignment and would have cost impacts of their own.

In addition to funding issues, we are also concerned about the loss of synergy caused by breaking up nuclear weapons interface activities between the Air Force, the Defense Nuclear Agency, the Department of Energy, and the Sandia National Laboratories. Many activities such as the Department of Energy's Accident Response Group are deployed from Kirtland Air Force Base. This group, which is comprised of the Department of Energy, the Los Alamos National Laboratory, the Sandia National Laboratories, and other Department of Energy organizations, is responsible for responding to any accident involving a nuclear weapon anywhere in the world. None of these problems are insurmountable. However, they are of concern to the Department of Energy and could be expected to result in the unnecessary commitment of resources, which would not be needed under the current base alignment.

Still another concern centers around the Kirtland Underground Munitions Storage Complex. As presently envisioned, this facility would be located in the Department of Energy/Sandia National Laboratories cantonment. With a reduced Air Force presence on the base, it would be uncertain that the Air Force can maintain this facility for the long-term.

The eastern portion of Kirtland Air Force Base is an area which is currently used by the Department of Energy, the Sandia National Laboratories, and the Air Force Phillips Laboratory for critical program purposes. Use of that land and facilities would not likely change with the reduced Air Force presence. This area has significant hazardous activities that would preclude increased public access to those areas. These hazards include unexploded ordnance, live fire ranges, physics experiments, and areas requiring environmental remediation.

As you proceed with your review of the potential realignment of Kirtland Air Force Base and the public hearings, the Department of Energy is prepared to assist the Defense Base Closure and Realignment Commission to ensure that the overall impact of the proposed action is fully understood before final decisions are made.

Sincerely,

Hazel R. O'Leary

Hazel R. O'Leary

BRAC COMMISSION QUESTIONS
23 March 1995

1. Why does the Training Facility need to stay at Williams AFB?

The 1995 DOD recommendation is to reverse a previous BRAC decision to move the Williams AFB Armstrong Laboratory Operating Location to Orlando FL. Originally, the decision to move the AL-OL to Orlando was based on assumptions regarding Naval Training activities and availability of facilities. Since that time, the Navy has reduced its pilot training activities at the Naval Training Center in Orlando and facilities were not available at the BRAC 91 estimated cost. As such, the AF recommends that the AL-OL remain at Williams AFB. Primarily, the AL-OL at Williams AFB is a civilian operation that is better suited to remain in the current location. The facilities are unique and well suited for research activities and the close proximity to Luke AFB provides a ready source of fighters pilots who can support the function as consultants and research subjects.

2. Why does the Armstrong Laboratory have to go to WPAFB?

The Department of Defense BRAC 95 recommendation to move the Armstrong Laboratory to WPAFB was justified as "the Air Force has more laboratory capacity than necessary to support current and projected AF research requirements." The excess capacity judgment was apparently based on the assertion that WPAFB had, available, adequate administrative and office buildings proposed to accommodate the research activities of the Armstrong Laboratory. It should be noted that not all of Armstrong Laboratory would move to WPAFB. The DOD BRAC 95 recommendation did make allowances to move the AF Drug Testing Laboratory to another location in San Antonio and the Hyperbaric Chambers to Wilford Hall Medical Center.

3. Why can't AL/OE go to Tyndall AFB FL?

The move of AL/OE to Tyndall AFB is not in the best interest of the Air Force. The rationale is as follows:

a. The primary synergism in our various environmental activities is between AL/EQ, which works remediation and compliance technologies and is already at Tyndall AFB, and AFCEE, which serves as technology transition agent for these remediation/compliance technologies and is recommended for relocation to Tyndall AFB under BRAC 95.

b. AL/OE's mission, which includes toxicology studies of new materials and the effects of directed energy systems on crew members, is substantially different from the AL/EQ mission. The Directorate's mission also includes Bioenvironmental Engineering and Occupational Medicine consultation to field units. Thus, there is much more synergism between AL/OE and other Brooks units (i.e. the USAF School of Aerospace Medicine and other AL directorates) moving to WPAFB than there is with AL/EQ or AFCEE.

4. Why can't Pollution Prevention go to Tyndall AFB FL?

Wright Laboratory's Materials Directorate Pollution Prevention Mission (WL/MLSE), which is focused on environmentally benign materials and processes, is also substantially different from the AL/EQ mission. Moving this activity to Tyndall AFB would disrupt the existing synergism with WL/ML's mainstream mission of broad based aerospace materials and processes research, and would also result in significant move costs.

DISCUSSION ITEM
MILITARY VALUE OF
HUMAN SYSTEMS CENTER

1. DESCRIPTION OF TOPIC: This paper presents the Military Value of HSC, i.e., its continuing mission to provide a USAF core technology - HUMAN SYSTEMS, and the management and infrastructure to foster this core technology.

2. RELEVANT FACTS: This paper is based on AFMC 21 strategy, assumptions, constraints, and considerations. The following elements are relevant to this issue:

-IWSM is the primary management and organizational philosophy of AFMC.

-Human Systems was identified as an Air Force and Joint Cross Service core technology.

-AFMC-21 goals were to:

-Maximize collocation of RDT&E, Acquisition, and Sustainment

-Maintain minimum essential core capability in RDT&E Acquisition, & Sustainment

-Achieve representative collocation with the full range of customers supported

-Maintain flexibility to respond to future changes in customers' needs and/or funding

-The USAF core technology called HUMAN SYSTEMS is made up of numerous interrelated scientific and engineering disciplines which may be grouped as follows: LIFE SUPPORT/CREW SYSTEMS; ENVIRONMENTAL, SAFETY, & OCCUPATIONAL HEALTH; PERSONNEL/TRAINING; and MEDICAL/AEROMEDICAL SUPPORT

3. ANALYSIS: HSC manages the HUMAN SYSTEMS core technology across the complete spectrum of the acquisition process following IWSM principles. The Science and Technology mission is carried out by the Armstrong Lab. The program management and sustainment is executed by the Human Systems Program Office, a "basket SPO". HSC's education and training function are performed by the USAF School of Aerospace Medicine and the Systems Acquisition School. The base operating support comes from the 648th Air Base Group, the 615th Medical Squadron, and HSC's Environmental Management Office.

The entity known as the Human Systems Center provides integration and support across all the many scientific and engineering disciplines of the HUMAN SYSTEMS core technology and across the acquisition cycle. HSC management must understand the complete spectrums of both the Human Systems core technology and the acquisition cycle. With this corporate knowledge it can act as the good faith broker and decision-maker empowered by AFMC to nurture, mature, and sustain this USAF core technology. HSC requires a small headquarters staff since its primary corporate management tools are its Quality and Corporate Councils .

HSC was actively involved in all four Reliance Technology Planning Process forums: Armed Services Biomedical Research Evaluation Management, Joint Directors of Laboratories, Training and Personnel Systems Technology Evaluation and Management, and the Joint Engineers. As a result, all DOD work will migrate to HSC in toxicology, laser bioeffects, radio frequency bioeffects, and biodynamics.

Under the command of HSC, the units at Brooks AFB, and all geographically separate portions of HSC, operate today as an integrated team to bring human-centered science to the battlefield and workplace. HSC teams acquire and support assets that train and equip, making Air Force people more effective, productive, and safe.

HSC converts Human Systems requirements into operational systems through cradle-to-grave management, a long-term commitment that enhances teamwork and partnerships. HSC's seamless organization contains processes critical to the maturation and development of products throughout their life cycles. Armstrong Laboratory and the Human Systems Program Office cultivate a specialized infrastructure to support Integrated Product Development teams that use a deliberate, disciplined approach to product development and enhancement. Streamlined processes also simplify customer-supplier relationships. A single business decision authority likewise increases control and flexibility for both development and sustainment activities.

An alternate approach is to align the components of HSC with their like functions, i.e. SPOs, Labs, and Schools. Fragmenting responsibility for these functions and for their day-to-day support removes integration and will severely degrade their performance. The cost of this degradation is difficult to quantify. However, it is apparent that vital IWSM linkages will be broken across the entire HUMAN SYSTEMS core technology.

4. CONCLUSION:

1. It is advantageous to foster core technologies throughout their life cycle, i.e., IWSM principles should be applied to our core technologies.
2. The entity known as HSC should be retained as an IWSM center managing the HUMAN SYSTEMS USAF core technology.
3. AFMC Option 4 will address the feasibility of the physical relocation of this core technology center.

5. RECOMMENDATION: Rather than fragmenting HSC, we should continue to bring like functions together from throughout DoD to form a national center of excellence for environmental matters, aviation medicine, and all aspects of human performance.

ISSUE PAPER
ON
MILITARY VALUE ANALYSIS
OF
BROOKS AFB
(Deliverable 4.1.2.H)

1. **ISSUE:** This paper discusses the interrelated organizations and capabilities, which as an integrated whole, show Brooks AFB to be militarily unique and mission essential.

2. **BACKGROUND:** Brooks AFB is the home of three major USAF organizations with strong mutually beneficial common bonds. These organizations are the Human Systems Center (HSC), the Air Force Medical Support Agency (AFMSA), and the Air Force Center for Environmental Excellence (AFCEE).

a. HSC, the advocate for the human element across all USAF mission areas, is guided by the principle: "THERE ARE NO UNMANNED SYSTEMS." HSC as a corporate entity can be divided into three functional areas: Senior Leadership, Products and Services, and Base Operating Support. The leadership function establishes and integrates the operating environment. HSC strives to maximize human capability, performance, protection, and safety through integration of the disciplines of education, science and technology, acquisition, and preventive medicine. Further, HSC's product/service lines could not exist without the required support functions, which also provide the infrastructure for all three major Brooks organizations.

b. The mission of AFMSA is to assist the Air Force Surgeon General in developing programs, policies, and practices relating to Air Force health care in peace and war. It acts for the Surgeon General to put policies and directives into effect. The office is organized into the directorate of health care support, and selected professional affairs and quality assurance activities.

c. The mission of AFCEE is to provide the Air Force with an in-house capability to handle all aspects of environmental cleanup, planning and compliance. Its three operational directorates are Environmental Services, Construction Management, and the Air Force Design Group.

3. **DISCUSSION:** The missions of the three major organizations have been and will continue to be central to USAF goals and objectives. The missions are complimentary and interrelated.

a. In addition to their responsibilities as Air Staff Separate Operating Agencies, AFMSA and AFCEE are the on-site representatives for two of HSC's major customers: the Air Force Medical Service (AF/SG), and the Air Force Civil Engineering community (AF/CE). This collocation and direct daily interaction with HSC supports the goal of the Air Force Medical Service's Integrated Medical Systems Management (IMSM): to assess current medical technology and information systems acquisition processes and identify future enhancements.

b. HSC is internationally recognized for its human centered research, development, and education. It is a center of excellence in aerospace medical research; clinical consultation; medical and environmental education; hospital planning, construction, and information systems; acquisition of integrated aircrew life support and chemical defense equipment, intelligent tutoring, and medical and environmental systems; drug testing; hazard material handling and sample analysis; and base cleanup and restoration. The Brooks AFB installation has unique, high value, one-of-a-kind man-rated facilities; close proximity to several high-caliber academic and corporate research institutions and professional libraries; and a science and engineering staff of more than 1000 individuals, over 300 with doctoral degrees. A significant synergy exists between tech base research, clinical medicine, acquisition, and the teaching functions that make each more effective.

c. Besides the normal infrastructure responsibilities of a host, the HSC commander has a special role to both AFMSA and AFCEE. As well as being the HSC Designated Acquisition Commander (DAC), he is the decision authority for all major acquisition initiatives. Through his role as the HSC commander, he provides both AFMSA and AFCEE with their required contracting and comptroller functions.

d. The sustainment arm for items developed and fielded at Brooks AFB is located just a short drive across town at Kelly AFB. Aligned with its sustainment arm at Kelly AFB, Brooks AFB fulfills all the goals of AFMC's cornerstone: Integrated Weapon Systems Management (IWSM).

4. **CONCLUSION:** The missions, interrelationships, and synergy of the organizations on Brooks AFB demonstrate it to be militarily unique and mission-essential. Two major Air Staff customers, residing on the same installation with their AFMC supplier, further enhances and enforces IWSM goals. The retention of a human systems single manager and DAC maintains integrated institutes for human centered research, development, acquisition, education, and environmental quality. Brooks AFB incorporates all the IWSM/IMSM organizations and their customers into an interrelated and interactive whole -- the goal of AFMC-21. This consortium of institutes is the best value for the taxpayer and the US Air Force.

Document Separator

HUMAN SYSTEMS CENTER
PRODUCTS AND PROGRESS
"THERE ARE NO UNMANNED SYSTEMS"

HUMAN SYSTEMS CENTER PRODUCTS AND PROGRESS

"There Are No Unmanned Systems"

Issued by
HQ Human Systems Center (AFMC)
2510 Kennedy Circle, Suite 1, Brooks AFB, Texas 78235-5120

Designed and Produced by Melissa M. Tarleton
HQ HSC Planning, Requirements, and Engineering
Marketing Office
October 1993

Contents

Vision, Missions, Goals, and Guiding Principle

AIR FORCE VISION: *Air Force people building the world's most respected Air and Space Force ... Global Power and Reach for America.*

AIR FORCE MISSION: *To defend the United States through the control and exploitation of air and space.*

AFMC MISSION: *Through integrated management of research, development, test, acquisition, deliverance, and support, we advance and use technology to acquire and sustain superior systems in partnership with our customers. We perform continuous product and process improvement throughout the life cycle. As an integral part of the USAF Warfighting Team, we contribute to affordable combat superiority, readiness, and sustainability.* ***AFMC goals are:***

GOAL 1: SATISFY OUR CUSTOMERS' NEEDS--IN WAR AND PEACE

GOAL 2: ENABLE OUR PEOPLE TO EXCEL

GOAL 3: SUSTAIN TECHNOLOGICAL SUPERIORITY

GOAL 4: ENHANCE THE EXCELLENCE OF OUR BUSINESS PRACTICES

GOAL 5: OPERATE QUALITY INSTALLATIONS

HUMAN SYSTEMS CENTER GUIDING PRINCIPLE: *To make the human the heart of aerospace systems and operations.*

Quality Air Force: A leadership commitment and operating style that inspires trust, teamwork, and continuous improvement everywhere in the Air Force.

Commander's Assessment

Our bottom line concern at the Human Systems Center (HSC) is: **How well do we meet your human systems needs?**

In a very real sense, HSC's customers are virtually every man and woman in the USAF, and increasingly those throughout the Department of Defense. Now more than ever, with President Clinton's Defense Conversion initiatives and our technology transfer programs, HSC customers also include nondefense commercial industry.

Military or commercial, HSC products have one common denominator: they enable people to do their jobs ... better. While people have not changed biologically over the years, human-centered technologies have dramatically increased their ability to perform. This concept is clearly illustrated in athletics where world records seldom stand for more than a few years. Likewise, HSC's equipment, training products, and operational techniques make today's warfighters and support personnel far more capable than those of just a few years ago.

I invite you to tell us how we are doing. Use any of HSC's various feedback programs, the survey on the following page, or any method you choose to tell us how we can better satisfy your human-centered research and product needs. Our people solicit your inputs and are empowered to respond with programs, procedures, or other changes to improve HSC's product quality.

This brochure presents a cross section of HSC's human-centered technologies. These technologies will help keep America militarily and economically strong as we restructure our armed forces to meet unparalleled rapid changes in world military and economic environments. I encourage you to inquire about any HSC technologies which might have the potential to enhance your unit's mission performance. From your first inquiry for information, through HSC product delivery and support, our number one goal is to **meet your needs.**

George K Anderson

Major General George K. Anderson, USAF, MC
Commander, Human Systems Center

Human Systems Center Technology Feedback Survey

USE THIS FORM TO - -

- learn more about HSC technologies and how they can serve you;

and/or

- tell us how this publication meets your needs and how we can improve it.

---

1. Send me additional information about the following HSC technology area.
   (attach additional sheet if required)

2. How can HSC better serve your needs?
   (attach additional sheet if required)

3. Other comments!
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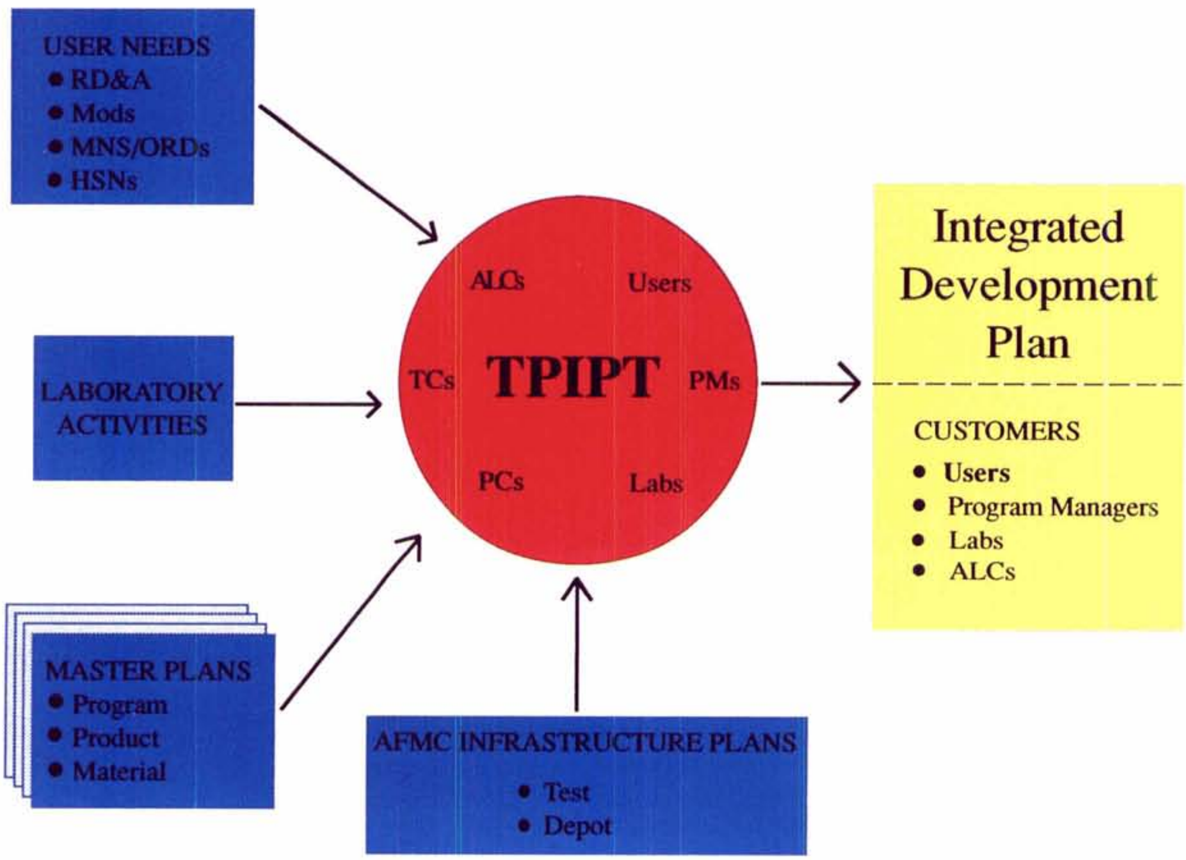
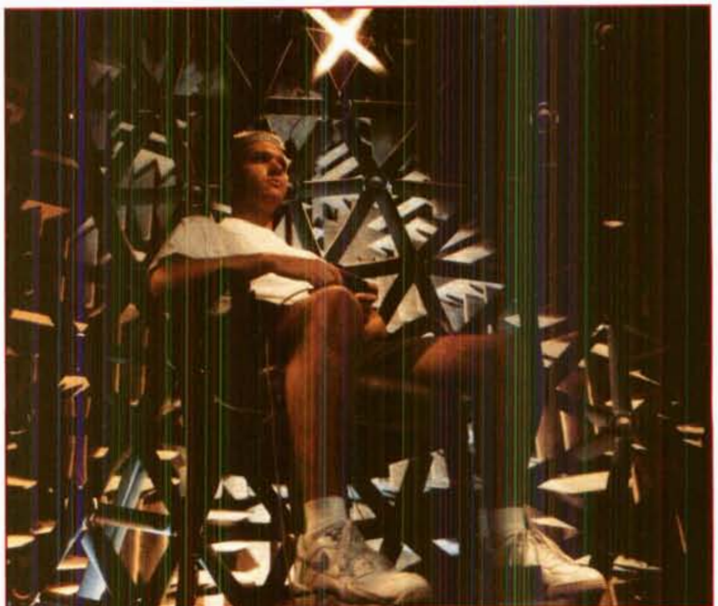
Technical Planning Integrated Product Teams

A Technical Planning Integrated Product Team (TPIPT) is a network of key players from operational and support commands who use an integrated product team approach to plan and facilitate superior solutions to the users' operational needs. Human Systems Center has two TPIPTs--Human Systems Integration (HSI), and Environment, Safety, Occupational Health (ESOH)--whose job is to provide solution alternatives for our customers' human-system issues, needs, and requirements.



The TPIPTs, located in HSC/XRT, provide a convenient point of contact for all research, development, and acquisition activities at HSC ... call us today at: (210) 536-4460 [DSN 240].

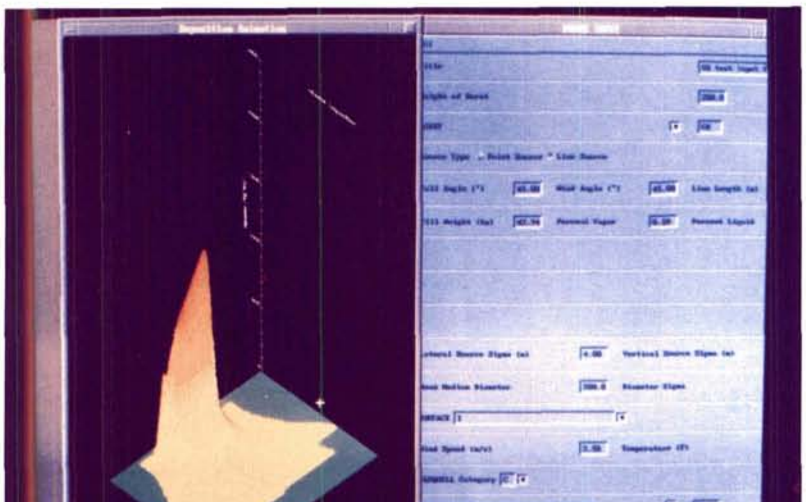
Crew Systems



This Human Systems Center product area accomplishes research and develops, fields, and supports technology and systems to optimize human combat performance and survivability to ensure weapons systems configurations are compatible with human operator requirements.

Nuclear-Biological-Chemical Operability Assessment

Although the traditional chemical and biological warfare threat posed by the former Soviet Union has diminished with the Union's breakup, vulnerability to attack by Chemical Biological Warfare (CBW) has increased. The proliferation of CBW agents is well known and documented. Two major factors behind this explosive rate of spread are opportunity and cost. The opportunity to acquire or develop CBW agents has probably never been higher. The technology is well established and the skills needed are the same ones required for commercial pesticide production or operations requiring fermentation. Equipment for production is readily available and supplied on the open market. Compared to the cost for similar capability offered by nuclear or conventional forces, the price tag for these weapons is quite low.



Computer simulation predicts contamination levels over battlefield area.

Nuclear-Biological-Chemical (NBC) Operability Assessment begins with developing a scenario unique to the study objective. In coordination with the intelligence community, threat assets, including agents and delivery systems, are identified and modeled for selected regions of the globe. Potential US and allied target assets are described and the appropriate meteorological and terrain data gathered. A "red team" composed of threat analysts, operational experts, and simulation specialists is formed, along with a reasonable CBW attack scenario. Simulation models are selected and computer simulations conducted. Output from the simulations include agent challenge levels, contamination areas and persistence, casualty estimates, and predicted operational degradation. Analyses such as these are used to determine technology requirements and procedures for NBC defense, design standards, and realistic planning and training environmental projections.

Some recent products are: (1) "Post" Soviet Union CBW challenge-level assessments for NATO air bases; (2) analysis of the vulnerability of Naval surface assets to CBW attack; (3) definition of worst case, but reasonable challenge levels, for ground crew ensemble design specification; (4) assessment of US forces' vulnerability to CBW in Southwest Asia (after Desert Storm); and (5) publication of updated chemical warfare toxicity standards. Current efforts include: (1) analyzing CBW threat after agent filled warheads have been intercepted by ground based air defense; (2) modifying high altitude chemical and biological dissemination models; (3) developing revised biological toxicity standards; and (4) defining baseline biological warfare equipment capabilities and improvement areas, and developing initiatives to improve capability. Finally, active participation continues in the form of NATO sponsored working groups of experts, international task forces, and ad hoc committees, to identify the CBW challenge environment across a broad spectrum of scenarios.

OPR: AL/CFHA, (513) 255-8869 [DSN 785]

Chemical Defense Aircrew Ensemble

The current chemical defense ensemble encumbers the crewmember so much that normal tasks are difficult and fatiguing. Continuous protection must be provided during transit from a collective shelter to the aircraft, during flight operations, and then back to the collective shelter. To meet this need, a new Chemical Defense Aircrew Ensemble, referred to as the CWU-66/P, was developed.

F-16 pilot wearing both the CWU-66/P Aircrew Ensemble and a separate respiratory protection mask.

Of two candidate materials considered during development test and evaluation, one fabric using carbon sphere technology proved to be more effective in repelling (and insulating against) chemical agents. This option, however, suffered from problems with comfort and stiffness. The only acceptable option involved further development of an effective material with acceptable physical characteristics. This new fabric, 80 percent Nomex and 20 percent softer fiber, successfully completed initial operational test and evaluation in September 1989. Aircrews stationed at 12 USAF bases participated in this evaluation. Fielding of this item was expedited in response to Operation Desert Shield/Storm. Over 24,000 ensembles have been fielded to date. Follow-on procurement of approximately 40,000 additional units is ongoing

The new one-piece chemical defense ensemble replaces the current aircrew chemical defense ensemble (Nomex flight suit, charcoal undercoverall, and long cotton underwear). It is compatible with the crew station, environment control, and ejection systems of all fixed wing aircraft. It is washable, cooler, lighter weight, nonflammable, and vapor agent protective. With the new chemical defense ensemble, aircrew members can effectively operate their weapon systems confident that they are protected from chemical agents.

OPR: HSC/YAC, (210) 536-2675 [DSN 240]

Chemical Defense Ground Crew Ensemble

The new Chemical Defense Ground Crew Ensemble (GCE) program will produce and field a garment which maintains a high level of chemical protection while greatly improving the ability of wearers to perform their duties in a chemical environment. The GCE program will also develop a decontamination process which extends the combat utility of the new ensemble. The current garment, which protects ground crewmembers against the effects of chemical warfare agents, was originally developed by the Army. This protection, however, has come at the expense of comfort, resistance to heat stress, and durability of the material.

The Human Systems Program Office (HSC/YA) worked closely with the Sustained Operations Branch of the Crew Systems Directorate of Armstrong Laboratory (AL/CFTO), to investigate potential technologies which could be used in the acquisition of the GCE. Human subject testing by AL/CFTO indicates that certain approaches for the new garment can provide chemical protection without increasing heat stress more than 20 percent beyond that currently caused by the standard issue battle dress uniform. Additional testing funded by HSC/YAC indicates that the new suit will be launderable and may even be capable of being safely reused after chemical agent exposure.

OPR: HSC/YAC, (210) 536-2675 [DSN 240]

Even when life threatening chemicals are present, the ground crew will be able to perform their mission with minimal discomfort.

10

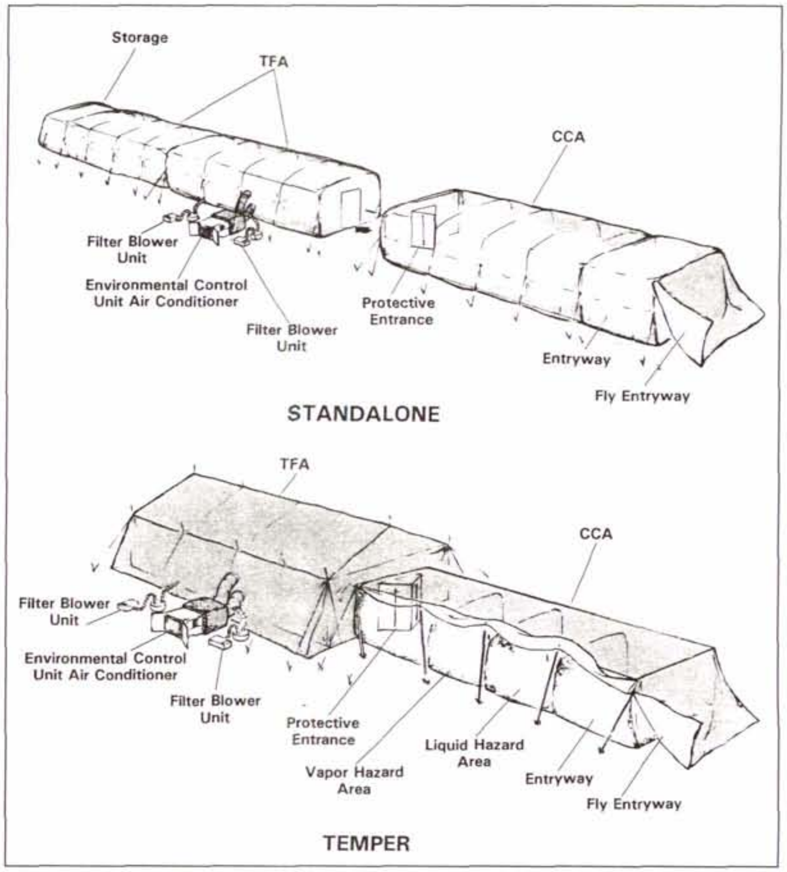
Transportable Collective Protection System

An operational need exists to provide the USAF with a chemical warfare (CW) collective protection capability. This capability is necessary to improve the USAF's ability to operate and sustain operations in a CW environment. In general, collective protection must provide a clean "shirt-sleeve" environment in which personnel can eat, drink, sleep, and perform duties which cannot be adequately performed while wearing individual protective equipment.

The Transportable Collective Protection System (TCPS) provides CW agent protection for mobility forces deploying to "bare bases." It can be transported by USAF cargo aircraft or by ship. The TCPS consists of a Contamination Control Area (CCA) and a host shelter modified for chemical protection using agent proof material and overpressure. Personnel process through the CCA, remove their chemical ensembles, and enter the bare base shelter to eat, sleep, or perform light work. The TCPS is available in three configurations: the tent, extendable, modular personnel (TEMPER) TCPS; the expandable shelter/container (ES/C) TCPS; or the stand-alone configuration in which two CCA units are combined to form the host shelter and a third CCA is used for processing.

United States Air Forces Europe is scheduled to become the first operational unit with the TCPS. Air Mobility Command, Air Force Special Operations Command, and Air Combat Command are also scheduled to receive TCPS units through FY97.

OPR: HSC/YAC, (210) 536-2675 [DSN 240]



A chemical liner is being installed in the "TEMPER" configuration of the TCPS tent during operational evaluation.

Wartime Medical Planning System

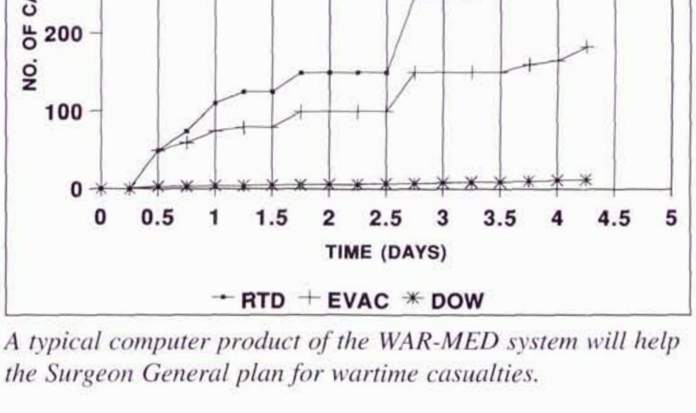
The mission of the USAF Medical Service is to rapidly expand, mobilize, and deploy medical support for USAF contingency operations. Varying threats and operational conditions worldwide make it extremely difficult to assess current capabilities and future requirements. USAF medical planners must have auditable databases and modeling tools for developing and assessing medical plans and support requirements if they are to optimize wartime medical assets for every site, within each theater of operations. The Wartime Medical (WAR-MED) Planning system has been identified as the Surgeon General's top priority development project.

The WAR-MED planning system is being developed to allow for the iterative analysis of integrated wartime medical systems. Straightforward data and graphical outputs will help the medical service to determine wartime manpower and resource allocations and to accomplish analyses of complex wartime medical plans and operations. Computer simulation and evaluation of service unique concepts of medical care, determining the impact of system or treatment changes, assessing the medical service's ability to return personnel to duty or to determine morbidity or mortality outcomes, based on assets employed, will be possible for the first time. This "tool" will assist in deliberate and crisis planning and in establishing realistic training requirements based on identifiable wartime tasks.

During the past year, the first and second echelon prototypes have been evaluated by the Human Systems Center, the USAF Surgeon General's Medical Readiness Division, and the USAF Medical Manpower Engineering Team. A third and fourth echelon model has reached the design phase of development and a concept phase for determining theater model characteristics is well underway.

The WAR-MED system will provide the USAF Surgeon General with the first auditable tool to assess the USAF wartime medical system, based on operationally significant measures of effectiveness. Planning system outputs are based on realistic scenarios and threats derived from the THreat RElated ATtrition (THREAT) System. This design concept allows for reconfiguration and avoids system obsolescence as the medical mission evolves to meet today's and tomorrow's challenges. It will have a significant impact on USAF medical deliberate and crisis planning.

OPR: HSC/YAM, (210) 536-2855 [DSN 240]



A typical computer product of the WAR-MED system will help the Surgeon General plan for wartime casualties.

12

Threat Related Attrition System

The success or failure of a military operation depends on the ability to deploy and maintain sufficient combat force. Understanding the causes and circumstances which result in losing deployed military personnel will allow accurate planning of personnel and logistical requirements, and can lead to strategies for prevention and mitigation. The limitations to such predictions are insufficient information concerning attrition factors and a lack of credible modeling tools to utilize this information. Other DOD agencies have decision-support models; however, these are not satisfactory as they are constructed to support service-specific concepts of operations or are based on notional weapons' effects and human tolerance algorithms. The THreat RElated ATtrition (THREAT) system seeks to produce this information relative to USAF needs in providing methodologies for its analysis and software for its application.

Full-scale weapons' effects studies have been conducted with general purpose bombs, fuel air explosives, tactical air-to-surface missiles, and precision guided munitions. The results of these studies have been incorporated into three models: unprotected, temporary, and permanent facilities. A prototype theater-level model was completed and exercised to produce attrition rates for the Korean theater. The Disease and Non-Battle Injury module was also completed and is now undergoing test and evaluation. During Operation Desert Shield/Storm, the THREAT system was used to conduct a special study for HQ USAF/XO to assess potential noncombatant casualties resulting from the air campaign.

The THREAT system will directly support USAF manpower, personnel, medical, operational, and logistical planners with deliberate and crisis planning. THREAT estimations, based on actual scenarios and human tolerance to weapons' effects, will provide an unprecedented reality to these plans.

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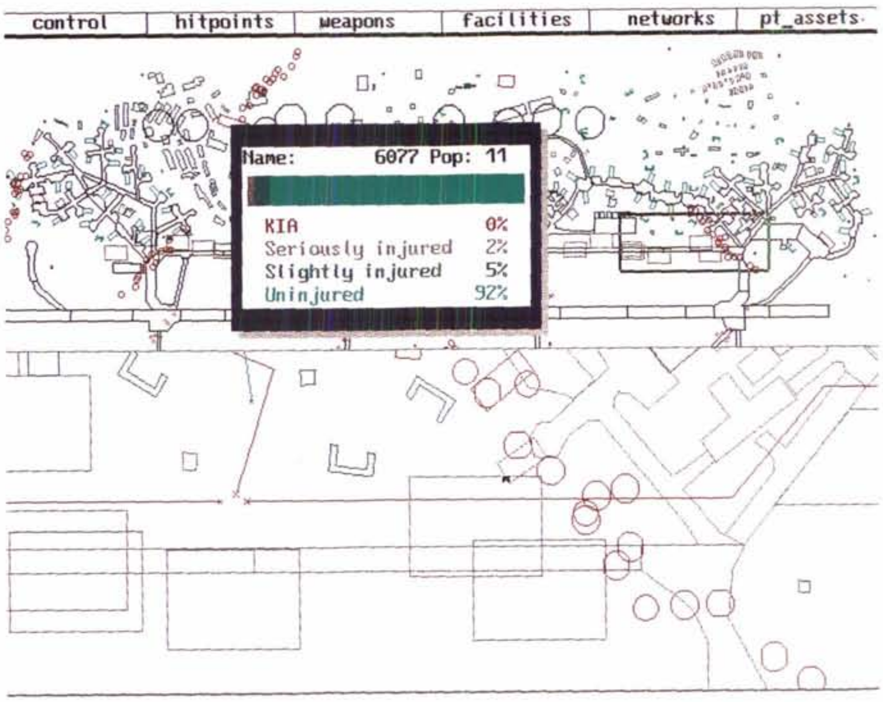


THREAT Installation-level graphical output.

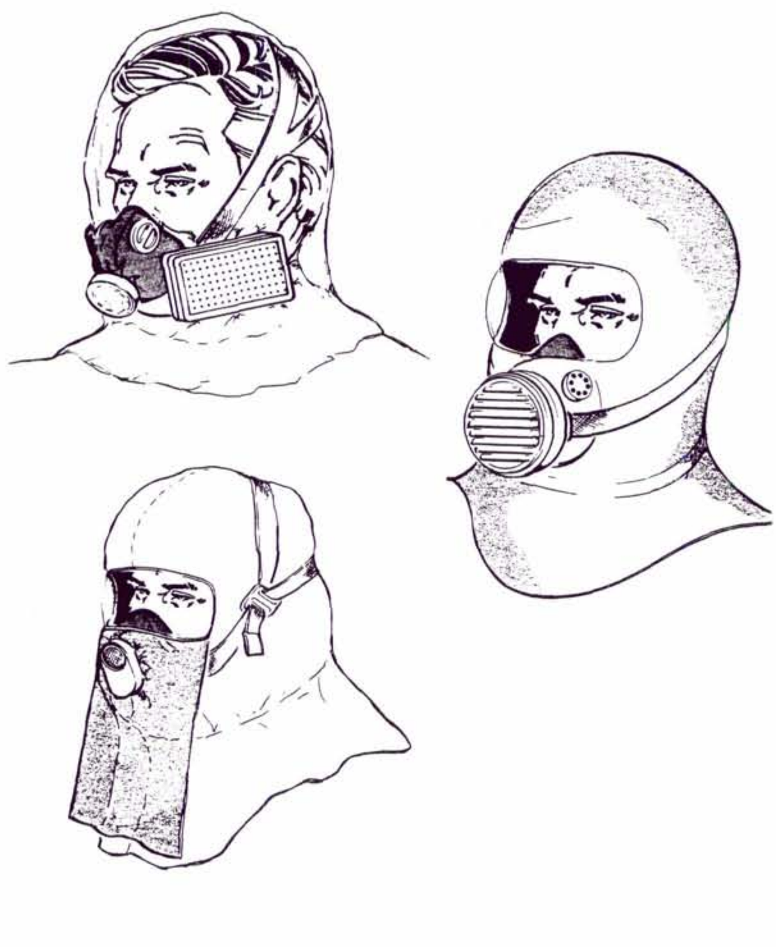
Disposable Eye/Respiratory Protection Program

The need for sustained operations in a chemical weapon environment led to a requirement for the Disposable Eye/Respiratory Protection (DERP) program. The DERP will consist of a hood with a filter to cleanse contaminated air, providing the wearer two hours protection against liquid, vapor, and aerosol agents. It will be sufficiently compact that it may fit into the pocket of the ground crew ensemble, the flight suit, and the anti-G suit. The DERP will be a low cost item; the goal is $15 per unit, allowing the mask to be disposed of after each use.

The DERP will be used in a contaminated environment and in a chemically protective shelter when the shelter filtration fails or when emergency evacuation of the shelter is required. In addition, other needs may exist for the emergency mask; these might include supporting aircrews deploying to high threat areas or supporting medical care providers and patients in certain instances.

Protection provided by the DERP mask will support the USAF's mission when personnel are unable to access their standard chemically protective mask/respirator. The payoff will be inexpensive protection for personnel, reducing casualties, and enabling the USAF to maintain a high sortie generation rate under adverse conditions. The ongoing development program will support the award of a production contract in 1995.

OPR: HSC/YAC,
(210) 536-2675
[DSN 240]



Three prototypes are currently being considered.

Aircrew Eye/Respiratory Protection System

The Aircrew Eye/Respiratory Protection (AERP) provides for an improved chemical defense capability for aircrew members. The AERP, referred to as the MBU-19/P, was developed to meet Air Combat Command, Air Mobility Command, and Air Force Special Operations Command requirements. This under-the-helmet system enshrouds a standard MBU-12/P oxygen mask with impermeable material. In addition to the mask/hood portion, the AERP system has a communications system and a blower unit. Upgrades of this system include Valsalva and drinking capabilities plus both tear-away and automated antidrown features for parachute landings in water. Aircrew responses to the AERP system have been positive.

Initial production of the AERP system was initiated in August 1990, followed by full rate production supporting Operation Desert Shield/ Storm. Initial production deliveries started in January 1991 with over 10,000 currently in the USAF inventory. Flight testing in all USAF aircraft, with the exception of development test and evaluation, and operational test and evaluation in the B-1, has been completed. Aircraft modifications to support AERP system integration are in progress at the Ogden, Warner-Robins, and Oklahoma City Air Logistics Centers.

Follow-on production will continue through the year 2001. AERP will ensure crewmembers are protected from chemical agents while maintaining the comfort, mobility, and function necessary to fly all DOD aircraft.

OPR: HSC/YAC and HSC/YAD, (210) 536-2675 [DSN 240] and (210) 925-3756 [DSN 945]

An F-16 pilot prepares for a mission while wearing Aircrew Eye/Respiratory Protection.

Personal Transatmospheric Protection System

As the USAF focuses its mission on projecting global reach--global power, HSC has started to include programs to support manned spaceflight in transatmospheric vehicles. The current high altitude platform, the U-2, utilizes a backup, unpressurized suit which inflates in the event of cabin depressurization. The suit, which is donned prior to flight, is extremely bulky. The crewmember has limited mobility and dexterity while wearing the suit, even when it is unpressurized, and the suit's inadequate ventilation leads to heat stress. These crews conduct long duration flights which, when combined with the suit's shortcomings, result in extreme fatigue and degraded performance.

The Personal Transatmospheric Protective System (PTAPS) program, started in FY92, is a critical experiment for developing and demonstrating improved technology to be incorporated into a full pressure suit. This technology will be used in 21st Century high altitude and transatmospheric vehicles. The approach is to evaluate existing and near-term technology against mission requirements of the U-2 and National AeroSpace Plane (NASP)/NASP Derived Vehicles to determine all the deficiencies in the current suit.

Currently, work is being done on improved gloves and increased mobility joints. The goal is to create a more comfortable and usable suit, whether pressurized or not. The new gloves will offer improved tactility and will be designed to allow the crew to manipulate equipment more easily. The suit will also allow the crew to breathe oxygen en route, rather than prebreathe on the ground. This will reduce crew fatigue and the chance of decompression sickness. Future focus will include an improved helmet, better integration with altitude protection, and studies to decrease thermal stress.

OPR: AL/CFTS, (210) 536-2937 [DSN 240]

Advanced pressure suit technology developments will improve mobility and dexterity, while operating at higher pressures.

Aeromedical Evacuation Equipment Development

Medical equipment must be able to transit the entire casualty evacuation system. The environment onboard aircraft is considerably more hostile to equipment and patients than that of ground based hospitals. Equipment may be subjected to wide temperature changes, rapid changes in air pressure, and intense vibrations, along with unusual power supply problems and limitations. Additionally, demonstrations must prove that medical equipment proposed for air evacuation missions does not interfere with normal functioning of aircraft systems.

A variety of aeromedical items have been evaluated for customers across DOD. The equipment tested has been proposed for use by medical care providers for all phases of casualty care, with primary emphasis on air transport. Not only have off-the-shelf medical equipment items been evaluated, but also developmental prototypes and the test equipment itself. Ventilators, cardiac monitors, suction equipment, intravenous infusion pumps, and neonatal transport incubators are but a few of the many items which have been tested during the past year. Recent developments in the area of molecular sieve oxygen generation and ventilator control logic show potential for merging these technologies to provide unlimited medical quality oxygen on aeromedical evacuation airframes. This will significantly enhance the patient care capabilities of strategic aeromedical evacuation.

Air Mobility Command (AMC) has been tasked by DOD to transport sick and injured personnel during both peacetime and wartime. To provide the highest standard of care, AMC relies on state-of-the-art medical equipment which has been tested and found to be safe and reliable for use in aeromedical aircraft. HSC's Armstrong Laboratory is the only DOD laboratory which evaluates medical equipment to meet this standard. Benefits to the USAF are an increased inventory of medical equipment available to meet specific user needs, and the assurance that the equipment is safe for treating and monitoring acutely ill patients onboard USAF aircraft.

OPR: AL/CFTS, (210) 536-2937
[DSN 240]

A vibration study is conducted on a C-9A to validate test criteria for air evacuation medical equipment.

Molecular Sieve Oxygen Generating System

The B-1B Molecular Sieve Oxygen Generating System (MSOGS) separates oxygen from engine bleed air to produce a clean, oxygen enriched breathing gas for the aircrew. Oxygen is separated by adsorbing the nitrogen component of the bleed air onto a synthetic, aluminosilicate zeolite molecular sieve. The nitrogen is subsequently vented overboard. The B-1B MSOGS is presently being recertified since the type of molecular sieve will change in the near future, in that the original molecular sieve will no longer be manufactured. The Armstrong Laboratory (AL), working in cooperation with the Aircraft Program Office, the air logistics centers, and the aircraft contractor, is performing flight qualification testing and man-rating of the modified B-1B system. This testing will ensure the new system meets the aircraft specifications, and hence, produces acceptable oxygen concentration levels during all mission profiles.

This newly patented 99 percent MSOGS technology will be transitioned to the civilian sector. Near term technology transition plans include: licensing to a commercial company, initiating a Cooperative Research and Development Agreement to further develop this technology, and a Joint Research and Development Program with the US Navy to incorporate this technology in an AV-8B Harrier ground support unit. The current MSOGS is limited to generating oxygen concentrations of 93-95 percent, even under ideal conditions. The 99 percent MSOGS technology is capable of producing oxygen concentrations of up to 99.7 percent, satisfying the requirements of Military Oxygen Specification MIL-O-27210. This novel technology will represent the next generation of aircraft MSOGS systems.

AL scientists are pushing state-of-the-art MSOGS technology by advancing technologies which permit storage of large quantities of high-purity oxygen and improve MSOGS performance. Advances in miniature turbomachines for oxygen liquefaction will allow new systems to both generate and liquefy oxygen in a self-contained process. This liquefied oxygen will be used as a source of backup oxygen during the mission or for medical oxygen during aeromedical evacuation. MSOGS expert systems currently in development will revolutionize methods for improving MSOGS performance and will reduce engine bleed air consumption. These advances in MSOGS technology support AL's ultimate goal of delivering the best MSOGS technology to our users--the best aircrews in the world.

OPR: AL/CFTS, (210) 536-3361 [DSN 240]

Recertification of the B-1B MSOGS.

Thermal Flashblindness Protection Device System

The Thermal Flashblindness Protection Device (TFPD) system is designed to protect the aircrew member's eyes from flashblindness and retinal burns caused by the radiation from single or multiple nuclear flash events. Formal qualification testing on this off-the-shelf device is pending establishment of a clear use requirement. All test data collected will be analyzed, interpreted, and retained for potential future use. The TFPD utilizes state-of-the-art lanthanum-modified lead zirconate titanate (PLZT) similar to the lens in the current USAF flashblindness goggles, the EEU-2/P system. When the photo sensor senses the ambient light, reaching the level of a nuclear flash event, voltage is applied across the lenses causing them to become opaque. While opaque, the lenses shield the eyes from harmful light and radiation. Once the ambient light falls to a safe level, the lenses become clear again, restoring the crewmember's normal vision.

The system is small and lightweight, weighing approximately 5 ounces. Unlike the current inventory system, the TFPD has a self-contained power supply (a 12-volt battery) and fits under the visors of all standard issue flight helmets. It will be a welcome change from the bulky helmet-mounted EEU-2/P goggles.

OPR: HSC/YAS, (210) 536-2854 [DSN 240]

The TFPD system is small, lightweight, and fits underneath the standard issue helmet.

Laser Protection and Personnel Susceptibility

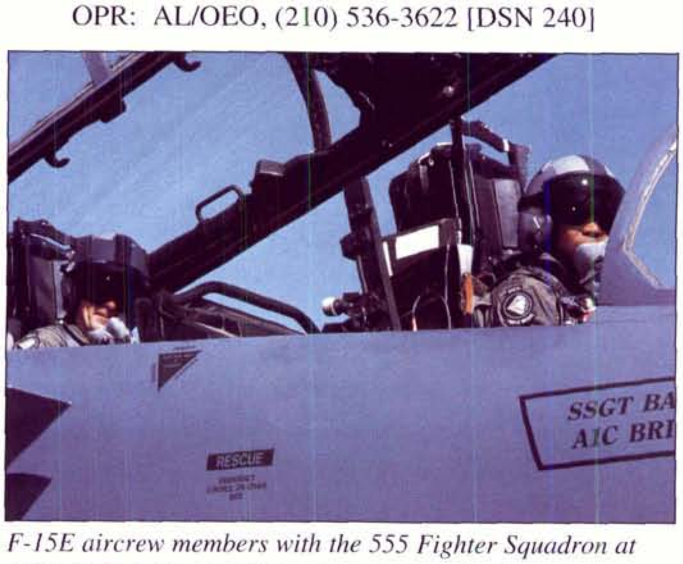
Optical technologies (e.g., lasers, optical munitions) could alter the air-land battlefield and enhance peacetime security operations. Third World nations could obtain low cost man-portable lasers for use as air defense weapons capable of defeating aircrew vision and aircraft sensors. Less than lethal effects could reduce wartime collateral damage or increase options to security forces for peacetime operations.

Exploratory and advanced development programs are underway to improve the modeling and simulation of personnel susceptibility and to transition new eye protection devices. The goals are to determine the vulnerability of personnel to optical technologies and develop protection devices suitable for many military operations. The protection program uses both mature technologies available from industry and advanced materials transitioned by the Wright Laboratory to develop devices that maximize protection and minimize human factors' limitations.

Prototype laser visors are being developed in the Advanced Aircrew Vision Protection (AAVP) program. The FV-6, developed rapidly for Operation Desert Shield/Storm, was the first multiline protection against invisible laser threats approved by HQ Air Combat Command for nighttime operations in the A-10 and F-16. The FV-6 is being modified for use in the F-15E. Aircrew concerns about compatibility with cockpit instruments, runway lights, and exterior aircraft lights, as well as threat identification, are being addressed through joint development, test, and evaluation at Edwards and Luke AFBs. Other AAVP program goals are to reduce the cost and maintenance requirements of laser visors, and to develop combination sun-laser visors. The modified FV-6 will be suitable for use by Special Operations Forces, and security, medical, and maintenance personnel.

Estimates of personnel susceptibility to optical devices and threats contribute to the requirements definition and vulnerability assessment processes. Personnel Effects Models (PEM) are being developed to enhance the reliability and accuracy of the estimates. Manned simulators have been used to assess the PEMs, such as was done during the Counter Target Acquisition Study (CTAS) II. CTAS employed networked fixed-wing simulators, in force-on-force, free play exercises, to determine the vulnerabilities of aircrews to laser air defense systems. By simulating the visual effects of laser exposure, CTAS enabled man-in-the-loop assessment of the military implications of laser weapons—without exposing personnel.

OPR: AL/OEO, (210) 536-3622 [DSN 240]



F-15E aircrew members with the 555 Fighter Squadron at Luke AFB, Arizona test new laser eye protection.

Combined Advanced Technology Enhanced Design G-Ensemble

The high-G maneuvers made possible by modern fighter aircraft can exceed the physiological protection afforded by traditional life support equipment and training. The combat crewmember must therefore restrict the aircraft's maneuvers to levels below the aircraft's full performance capabilities or risk suffering severe fatigue and possible unconsciousness. This fatigue can limit sortie surge capability, affecting flight safety and overall performance of the pilot.

Equipped with COMBAT EDGE, pilots can tolerate greater levels of "G" force.

In 1988, Tactical Air Command requested that a system be developed to provide F-15 and F-16 pilots enhanced protection from the negative effects of acceleration by incorporating a pressure breathing apparatus in conjunction with a currently fielded anti-G suit. This system is called Combined Advanced Technology Enhanced Design G-Ensemble (COMBAT EDGE). It uses a new oxygen mask, a counter pressure vest, a helmet modification kit, a new oxygen regulator, G-valve, integrated terminal block, and pressure sensor line for the aircraft.

COMBAT EDGE was certified Safe-to-Fly in 1990 following man-rating testing by Armstrong Laboratory. Development test and evaluation and operational test and evaluation flight tests in F-16 and F-15 aircraft were successfully completed in 1990 and 1991, respectively. Full rate production has commenced, and many F-16 units have already been equipped with this fatigue-fighting life support system.

OPR: HSC/YAS, (210) 536-2854 [DSN 240]

Advanced Technology Anti-G Suit

The anti-G suit used by USAF high-performance aircraft pilots represents technology dating back to the 1940's. The protective value of the current suit cannot match the high-Gz onset rate and sustained acceleration capabilities of modern aircraft. The Advanced Technology Anti-G Suit (ATAGS), developed by the Armstrong Laboratory, is intended to replace the currently fielded anti-G suit. No cockpit modifications are required for the system. The ATAGS can be used with or without Combined Advanced Technology Enhanced Design G-Ensemble (COMBAT EDGE). The ATAGS is a full coverage uniform pressure system designed to more effectively prevent pooling of blood in the lower body, one of the causes of the adverse effects of sustained acceleration. Full coverage means that counterpressure covers almost the entire lower body including the feet. Uniform pressure is achieved by surrounding the legs with pressure bladders rather than using smaller bladders and stretched fabric.

ATAGS reduces aircrew fatigue by decreasing the effort required for the anti-G straining maneuver. As compared to the existing suit, the ATAGS offers a 60 percent improvement in endurance during high acceleration—an indication of reduction in fatigue. When combined with COMBAT EDGE, a 450 percent improvement in endurance is seen. By reducing fatigue, fighter pilots can sustain performance during multiple air engagements and multiple sorties. During the past year the ATAGS has been significantly modified to improve comfort and operational acceptability. A series of man-rating evaluations (altitude, cockpit and equipment integration, and acceleration) were completed in preparation for an Early Operational Demonstration in cooperation with Air Combat Command. This demonstration consisted of a series of flight tests to collect using community comments before completing systems development. The ATAGS was successfully flown on more than 37 sorties in the F-15 at Langley AFB VA. The evaluation is continuing at Hill AFB UT in the F-16. Pilots using the ATAGS have been very enthusiastic about the tactical advantage offered by the suit. Transition to the Human Systems Program Office began in 1993.

The ATAGS addresses the most pressing problems associated with high-acceleration flight—performance compromise and G-induced loss of consciousness. By providing the crewmember with superior life support systems such as ATAGS, combat capabilities will improve while loss of lives and aircraft will decrease.

OPR: AL/CFTF, (210) 536-3811 [DSN 240]

ATAGS produces increased pilot tolerance to the high-G environment.

Aircrew Life Support

The Armstrong Laboratory (AL) Crew Technology Division is heavily involved in development programs for advanced aircrew life support and protective equipment. Recent advances in aircraft operational demands and capabilities have necessitated adding protective equipment, resulting in an increasing burden on the aircrews. In addition to the traditional flight gear and life support equipment for altitude, acceleration, hearing protection, and egress and survival, the aircrews are now being laden with systems for chemical/biological and enhanced acceleration protection, passive antidrown capability, helmet-mounted electro optical devices, and laser/flashblindness protection. The Cockpit and Equipment Integration Laboratory (CEIL) of the AL Crew Systems Division has been providing essential input concerning possible integration problems and proposed solutions.

Test subject conducting water immersion tests wearing an experimental anti-G suit and full complement of aircrew personal protective equipment.

Collocated with the USAF Life Support Systems 6.3 Advanced Development Program Office, and associated with the Human Systems Program Office at Brooks AFB TX the Cockpit and Equipment Integration Laboratory has conducted tests and evaluations on several new systems. As an integral part of the Advanced Technology Anti-G Suit Development program, the CEIL was instrumental in identifying critical design problems early, which limited emergency egress by larger crewmembers. Due to the involvement of cockpit integration early in the program, needed design changes can be accomplished with minimal impact on schedule and costs, and will result in increased user acceptance and reduced risk for the 6.4 Engineering Development program. The CEIL also tested an early design of an integrated positive pressure for G and chemical protective systems, a proposed active noise reduction system, a hose modification to the Aircrew Eye/Respiratory Protection hood/mask, and two versions of modified masks for the Combined Advanced Technology Enhanced Design G-Ensemble. Evaluation of equipment within the CEIL allows problems to be identified prior to costly flight trials.

As new systems are proposed and advances made in future aircraft capabilities, emphasis on equipment integration and design optimization will continue to be a basic element of the AL Crew Technology Division's mission. Future direction focuses on alleviating the burden on aircrew members by developing novel approaches to combined protective capabilities and reducing the volume of equipment to be worn.

OPR: AL/CFTS, (210) 536-3361 [DSN 240]

Life Support and Chemical Defense Sustainment

Life Support was the USAF's "first" cradle-to-grave single manager concept to be approved by the Secretary of the Air Force for Acquisition under the Integrated Weapon System Management concept. The single manager, HSC/YA, through the Kelly AFB System Support Manager, continues to provide first-class real time field support to operational USAF units worldwide. With responsibility for all USAF life support equipment, parachute and egress equipment, and fixed seat safety restraints in cargo aircraft, the division successfully maintained the war readiness posture of all flying units. Besides the active USAF commands which depend on the over 7,000 stock issue items that YA provides, the US Army, US Navy, NASA, Department of Transportation (forest fire fighters), and over 70 different foreign countries that purchase life support military hardware from the US Government are supported.

With annual expenditures of over $50 million, an average month of acquisition activity typically includes awarding approximately 40 contracts.

The HSC/YA division is composed of five integrated product teams (IPT): Egress, Survival Equipment, Fixed Seats, Mishap Investigation, and Chemical Defense and Electronics. Each team has assigned logisticians, equipment specialists, item managers, engineers, and contracting officers. The recent conversion to IPTs has proven invaluable, since manpower has been reduced by defense downsizing.

The "single manager" leadership style of development and sustainment has already identified better methods to support fielded equipment like COMBAT EDGE and AERP. This "up front and early" interaction significantly reduces the life cycle cost of both products. Additionally, close working relationships laid the groundwork for the future acquisition of solid and reliable systems for all of our customers.

OPR: HSC/YAD, (210) 925-3756 [DSN 945]

Supporting flight operations requires that over 7,000 items of life support gear be maintained, improved, and available to the airmen in the field.

High Altitude Protection Research Program

Crew operations in high altitude aircraft and space vehicles require protective measures to overcome the physiological hazards of the hypobaric environment. Goals of the Armstrong Laboratory's High Altitude Protection Research program are aimed at defining safe exposure limits and supporting development of crew protection equipment and procedures. The research program is currently focused in three areas: pressure breathing, decompression sickness (DCS), and effects of exposure to extreme altitude (ebullism).

Altitude research is used to quantify DCS risk for high altitude and spaceflight.

A recent survey of U-2 pilots indicates that 60 percent have experienced DCS in flight. Altitude chamber simulations show a 73 percent incidence of DCS for a typical U-2 flight profile. Although DCS risk can be reduced by prebreathing 100 percent oxygen prior to takeoff, requirements for rapid sortie generation and extended missions limit the amount of time available for prebreathing. To provide improved DCS protection in these situations, the concept of in-flight denitrogenation was experimentally demonstrated and recently transitioned to Air Combat Command in support of the high altitude reconnaissance mission. This concept can also provide significant improvements in crew protection during high altitude airdrop missions. A computer based decompression model is being developed to standardize DCS risk assessment. A first generation model has been demonstrated and continued development, including verification and testing, is underway. Very little data concerning DCS limits for exposures above 30,000 feet are available; experimental studies are planned to fill this critical void. At these altitudes, positive pressure breathing is required for hypoxia protection. The physiological effects of this procedure on pulmonary functions are being investigated.

The High Altitude Protection Research Program provides a critical part of the technology base necessary to successfully accomplish the USAF mission of defending the US through control and exploitation of air and space.

The results of these research efforts are transitioned to operational commands in the USAF and NATO, as well as to Air Force Materiel Command System Program Offices involved with life support equipment and the development of future high altitude aircraft and transatmospheric vehicles. Results of this research are also transitioned to NASA in support of manned space programs.

OPR: AL/CFTS, (210) 536-3545 [DSN 240]

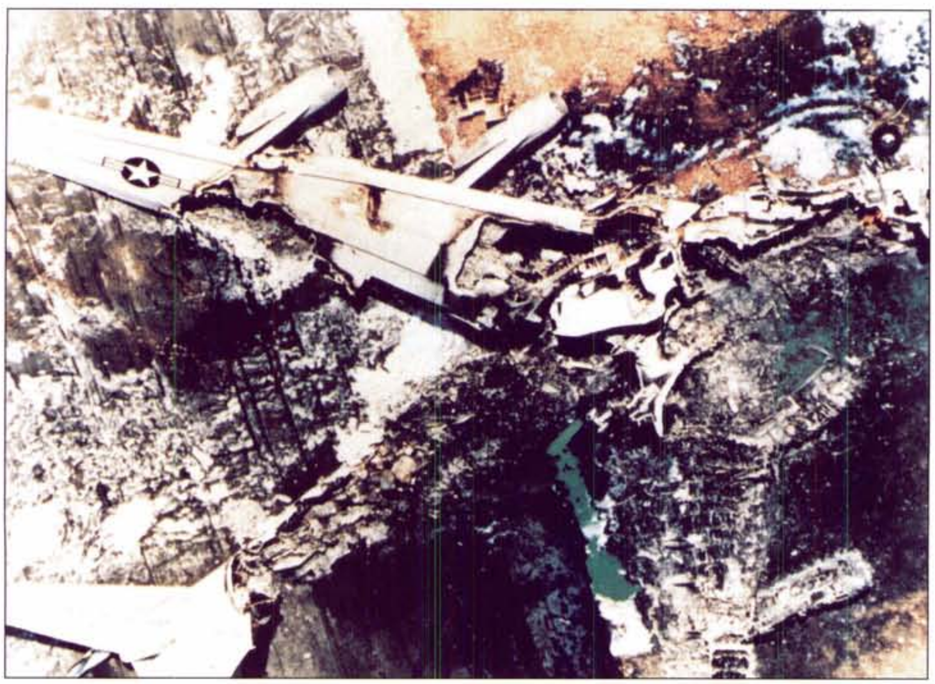
Aircraft Mishap Prevention System

Human factors contribute to more than two-thirds of the USAF's most serious class of mishaps. As a consequence, the annual costs are estimated to exceed $900 million with a loss of human life approaching 60 aircrew fatalities. The Air Force Safety Agency (AFSA) and mishap boards document human factors which lead to mishaps, but the exact significance and correlation of any specific factor in a mishap remain difficult to analyze. The Aircraft Mishap Prevention (AMP) system will be an automated tool designed to support the AFSA staff in collecting and analyzing human factors data related to aviation mishaps.

The AMP system is a distributed computer network which consists of two file servers, 25 workstations, a scanner, and associated peripherals. It will provide continuity and corporate memory by making human factors information readily available in a centralized repository. The AFSA analysts will use the AMP system to perform proactive analyses which solve difficult human factors problems and reduce aircraft mishaps by suggesting more effective preventive measures.

The AMP system will demonstrate an initial operational capability by FY94. When fielded, it will allow AFSA a more timely and comprehensive understanding of human factors in aircraft mishaps. It will have the flexibility and growth potential to accommodate future technology. By conservative estimates, the AMP system has the potential to reduce the aircraft mishap rate by 10 percent over a five-year period. The lives that will be saved are invaluable.

OPR: HSC/YAR, (210) 536-2477 [DSN 240]



Aircraft mishaps due to human factors can be significantly reduced, saving lives and resources.

Universal Water Activated Release System

Ejection from aircraft over water introduces additional hazards to the crewmember which are not primary concerns when ejecting over land. If the individual is unconscious or incapacitated, or if there are high surface winds or rough seas, the risk of drowning is significant. The current automatic parachute release system (AFSEAWARS) prevents the crewmember from being dragged through the high seas, but it is not compatible with the Capewell parachute release system used in the B-52 and KC-135. In addition, the AFSEAWARS failed to satisfy its reliability requirements, and its bulky design bruises crewmembers' arms. A follow-on system, the Universal Water Activated Release System (UWARS), alleviates these situations by providing a lighter, smaller, in-line device with increased reliability that is compatible with the Capewell, Frost, and Koch parachute release systems.

Compared to the AFSEAWARS, the new UWARS is significantly more streamlined and comfortable to wear.

UWARS incorporates the following technical improvements using 1980s and 1990's technologies: a semiconductor bridge initiator as the electro-explosive device; a printed circuit board; surface mount components; and a built-in test for battery voltage, polarity, and circuit continuity. UWARS requires low maintenance primarily limited to replacement of the batteries which will be stock listed items.

The UWARS development contract was awarded by the Human Systems Program Office in September 1991, the Critical Design Review was conducted in July 1992, and Development, Test and Evaluation (DT&E) started in February 1993. Operational Test & Evaluation and an option for production will follow DT&E.

OPR: HSC/YAS, (210) 536-2854 [DSN 240]

Advanced Recovery Sequencer

A recent adverse-flight conditions mishap of an A-10 aircraft outside the performance capability of the current ACES II ejection seat resulted in insufficient altitude for the parachute to fully open. Computer simulation of the mishap showed earlier deployment of the parachute may have saved the pilot. Consequently, the Accident Board recommended that a development program be initiated to investigate earlier parachute deployment at low altitude and moderate speed conditions.

The Advanced Recovery Sequencer (ARS) uses digital electronics coupled with electronic pressure transducers to more accurately determine the altitude and airspeed at the time of ejection. This information is fed to the sequencer and sets off a sequence of events to stabilize the seat once it has departed the aircraft. The ARS consists of two modules: the power module contains all the items necessary to provide power to the sequencer and the logic module contains all of the microprocessors and memory chips needed to process and store information. A major feature of the ARS is its ability to store the exact pressures and ejection times that existed at the time of ejection.

The ARS has improved maintainability. Intermediate- and depot-level test capability is built into the ARS. The power module and the electrical lines are replaceable at the intermediate level. The life of the ARS is 22.5 years, which represents a significant improvement in efforts to reduce life cycle costs of these types of components.

The ARS is fully qualified and is now scheduled for spare procurement for A-10, F-15, and F-16 aircraft; furthermore, it will be incorporated in the production seat for future F-16 aircraft. The ARS has even been identified as a baseline configuration requirement for the F-22 aircraft, and it represents the USAF's fervent pursuit of better and smarter ways to help save the lives of its aircrews.

OPR: HSC/YAD, (210) 925-3756 [DSN 945]

The ACES II seat lands at Holloman AFB, NM after a successful ejection test of the recently installed "Advanced Recovery Sequencer." Twenty-two seat ejections were accomplished for qualification of the seat with this critical new component.

Life Sciences Equipment Laboratory

The Life Support Mishap Investigation Lab is operated by the Human Systems Program Office's Life Support System Support Manager at Kelly AFB TX. USAF mishaps are investigated quickly, and technical reports and corrective actions are recommended. Board presidents, flight surgeons, and life support officers assigned to the mishap boards interface daily during active investigations. Annual training is provided for over 200 life support officers, life support superintendents and egress supervisors, thereby ensuring this core group can perform the first-level field investigations. The Mishap Investigation Lab ensures that one researcher is always available 24 hours a day to provide mishap boards with requested field expertise.

The lab maintains data and accident investigation histories (in accordance with AFR 110-14) to identify trends which could lead to future injuries or fatalities. All such deficiencies are immediately worked by the System Support Manager for correction via Technical Change Orders, equipment modifications, or recommended operational limitations.

The lab was established in 1983 and processes approximately 25 Class A mishaps annually. Extensive test procedures are developed to measure and interpret the various exhibits sent in for analysis. The full spectrum of metallurgical, dimensional, nondestructive inspection, fabric, chemical, and physical labs at Kelly AFB TX are fully available and easily energized to support these tests.

Recent assistance has been provided to the Joint Task Force for Full Accounting (JTFFA). This investigating team is charged with determining the status of missing in action in Vietnam. Several cases of national interest have been validated by the Mishap Lab's scientific methods applied to the remnants of life support equipment which have been discovered and returned for analysis. These analyses provided critical information supporting the JTFFA's cases and ensured that the necessary closure data could provide meaningful answers to concerned families.

OPR: HSC/YAD, (210) 925-3756 [DSN 945]

Discovering clues to the cause of any aircraft mishap often requires the expertise of the Life Sciences Equipment Lab.

Aircrew Spectacles

In 1990, a Human Systems Center study determined that 27.4 percent of USAF pilots and 51.5 percent of Navigators/ Weapon Systems Operators were spectacle wearers. HSC is responsible for developing optical devices for correction of aircrew vision and for integrating these devices with life support systems. The present aircrew spectacle frame, the HGU-4/P has been in the USAF inventory since 1958. Although the HGU-4/P has served well, there have been several significant advances in spectacle frame materials and design. The Armstrong Laboratory Ophthalmology Branch of the Clinical Sciences Division (AL/AOCO) was asked to find a sturdier frame that would be compatible with most life support systems and would have a wider field of view.

The attributes of the "ideal" aircrew spectacle frame were gleaned from a 1991 spectacle frame field study. An off-the-shelf prototype spectacle frame that possessed most of these attributes was chosen for further testing and evaluation. The new prototype aircrew spectacle frame meets ANSI Z-87.1 safety standards and has a flat black finish to reduce reflections and glint. It also has silicone nose pads for comfort and stability on the face when sweating or under G-acceleration. The larger eyesize of the new frame gives a wider field of view than the HGU-4/P. However, the total horizontal measurement of the new frame is less than that of the HGU-4/P which should make it more compatible with most life support systems. This was accomplished with a new wraparound hinge design.

AL/AOCO and the Air Warfare Center (AWC/TCO) at Eglin AFB FL will jointly field test the new aircrew spectacle frame. The frame will be evaluated for compatibility with life support systems, comfort (hot spots, weight, fit), stability on the face during G-load, acceptance by aircrew members, durability, reflections, field of view (checking six), and ease of adjustment by optometry technicians. Upon successful completion of testing and certification by the AWC, the aircrew spectacle frame will be recommended to the HQ USAF Surgeon General as the tri-service replacement for the HGU-4/P.

OPR: AL/AO, (210) 536-2745 [DSN 240]

New aircrew spectacles provide greater tensile strength and better field of view.

Infrared Voice Communications

Acoustic noise poses a serious problem for effective voice communications in operational environments such as chemical defense, aircraft maintenance, aircraft quick turnaround, cargo loadmaster, and emergency medical care. An Infrared (IR) voice communications system is being developed to provide personnel who perform tasks in these environments with the high level of intelligibility required for mission accomplishment.

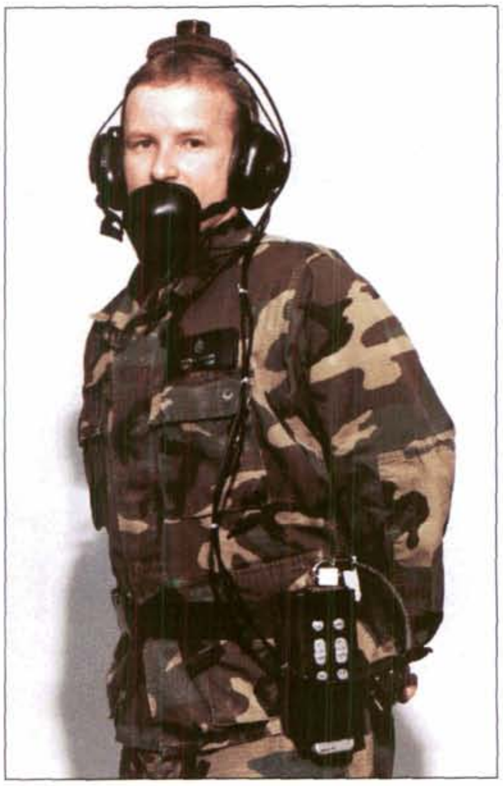
The IR system is a portable man-mounted voice communications system designed to operate with headsets and boom or mask microphones. The system provides a highly intelligible voice channel in conjunction with the noise attenuation provided by the headset. This allows the wearer to communicate with others wearing like systems in high noise environments. The lightweight transmitter/receiver mounts on the top of existing headsets and uses the standard microphones already fielded. The walkie-talkie sized electronics and rechargeable battery module mount on a belt. Since the system uses infrared light energy, it does not cause interference with radio frequency systems already in use for air base operations. Also, the transmission medium makes the system inherently jam resistant. The directional transmit range of the system is approximately 150 feet.

Demonstration models of the IR system technology have proven successful. The full design will include active noise reduction, omnidirectional transmit and repeater capability. The omnidirectional capability will allow personnel to operate at close range without the added task of aiming the IR beam. The directional transmit capability will be utilized for distant communications. The repeater system will be a portable module that will retransmit IR signals for extended range and allow communications around objects that would normally be obstructions in the IR transmission path.

The development of the IR communications system will result in better voice communications for personnel in high noise environments for the accomplishment of their missions. This technology can also be applied toward the development of voice communication systems in low noise environments such as military police and surveillance where portability and detection avoidance are requirements.

OPR: AL/CFB, (513) 255-3660 [DSN 785]

The IR voice communicator provides more intelligible communications in a high noise environment.

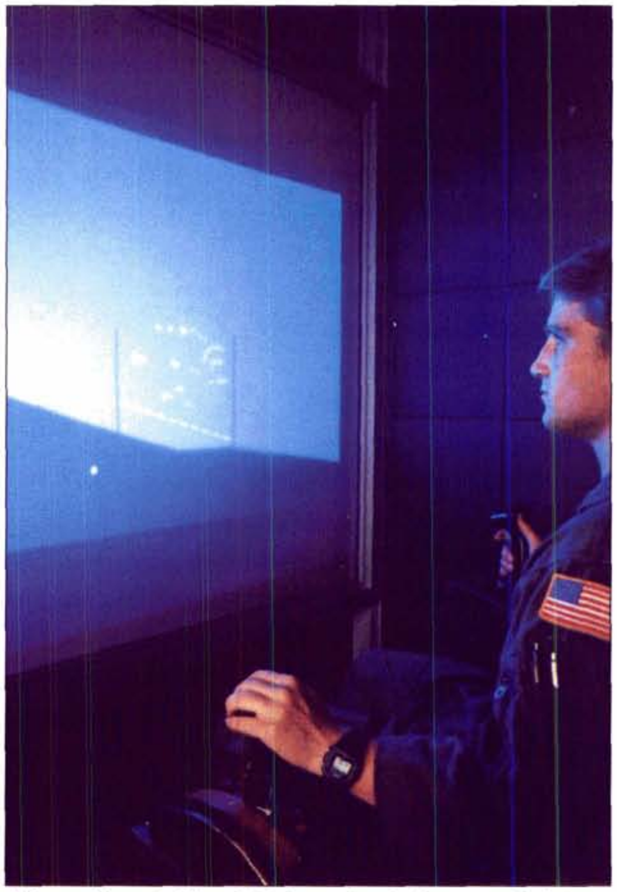


Heads-Up Display Symbology Evaluation

As a result of a series of aircraft accidents attributed to deficiencies in primary flight instrument symbology, HQ USAF/XO directed that cockpit displays, particularly Heads-Up Display (HUD) symbology, be optimized and standardized. Further emphasis on improving and standardizing primary flight displays was provided by the USAF Chief of Staff.

Armstrong Laboratory researchers compared, under rigidly controlled testing conditions, the HUD symbology elements to be evaluated. In the Visual Orientation Laboratory, USAF pilots participated in experiments requiring them to do precision instrument control tasks, unusual attitude recoveries, and instrument approaches while using various HUD symbologies. Ranking of efficacy of competing symbologies was based strictly on the pilots' performance while using them, but subjective ratings of the symbologies were also obtained.

The laboratory testing resulted in the following recommendations for standardized HUD symbology: (1) rotating pointers plus digits (counterpointers) for airspeed and altitude; (2) a variable-length arc around the altimeter for vertical velocity; (3) a climb/dive ladder with vertical and horizontal asymmetry (articulated bottom, tapered top, and left-side-only pitch numbers); (4) a "ghost" horizon to show the direction of the true horizon when the latter is outside the HUD field of view; and (5) "worm" and "caret" symbols for angle of attack and airspeed change rate, respectively. The recommended symbology elements were subsequently integrated into a draft standard symbology suite that was subjected to full-flight simulation and ultimately in-flight validation. As a result of successful completion of these phases, the recommended symbology will be incorporated into Military Standard-1787, Aircraft Display Symbology.


Pilot subject in Visual Orientation Laboratory helping to evaluate Heads-Up Display (HUD) symbology for standardization.

Flight display symbology development will continue in Armstrong Laboratory as improvements to the standard HUD symbology are proposed and as work progresses on optimizing and standardizing head-down and head-mounted flight instrument displays.

OPR: AL/CFTF, (210) 536-3521 [DSN 240]

Night Vision System

Modern warfare has led to an increase in airborne combat under the cover of darkness. Night missions include ground operations, takeoffs and landings in complete darkness, lights-off air refueling, and visual acquisition and identification of enemy targets hidden under the night sky. The current emphasis on flying aggressive missions with little visible light mandates that aircrews be able to see in ways that the human eye cannot. Devices called Night Vision Goggles (NVGs) currently exist and provide enhanced situational awareness for aircrews at night. Although NVGs permit operational effectiveness during these types of low-light operations, they are not safe to wear during an ejection from an aircraft. For that, and other reasons, an improved capability was required.

In 1988, Strategic Air Command requested the development of a Night Vision System (NVS) which would provide at least the same optical performance available from the currently used NVG known as ANVIS-6, but which would be lightweight, low profile, and ejection safe. Several other commands interested in improving their edge during low-level navigation, stealth operations, and target acquisition have cosponsored the program. The scope of this program now includes supporting bomber, attack, fighter, tanker, cargo, and helicopter, and various special operations for aircrews.

Two competitive contracts were awarded in 1993 for prototyping night visions systems. With the fielding of this advanced hardware, the safety of night training, the survivability of night missions, and the effectiveness of combat operations will be further enhanced.

OPR: HSC/YAS, (210) 536-2854 [DSN 240]

The Night Vision System provides an improved capability to see in low light/night conditions.

Aviation Night Vision Goggle Concept

The effectiveness of Night Vision Goggles (NVG) needs to be improved in several areas before the NVG can truly be adaptable for aircrew member use. In particular, improvements are needed in visual resolution (acuity), field of view, weight, and center of gravity. Enhanced night vision goggle designs are being explored through a Small Business Innovation Research (SBIR) effort. The program is being managed out of the Armstrong Laboratory Visual Display Systems Branch at Wright-Patterson AFB OH and has yielded some promising results.

Phase I explored alternative optical designs, with one chosen as optimum and selected for fabrication under Phase II. The Phase II design, currently called "Concept VI," has a minimum profile, adapts to the standard USAF issue helmet, and will fit underneath the helmet visor. A goal is for the NVG to be maintained on the helmet throughout the entire escape sequence for both ejection compatibility as well as use during descent. Anthropometry considerations, which are vitally important but often ignored, were implemented early in the design process. This has resulted in several independent adjustment features which provide an excellent optical fit. New and improved "hot" image intensifier tubes are part of the Concept VI design, allowing a wider field of view (45 degrees) and better visual acuity (20/26).

These critical performance parameters are far better than currently fielded systems, and offer a significant increase in night-fighting capability. The results of this SBIR effort are being supplied to the Helmet-Mounted Systems Technology Advanced Development Program Office and Human Systems Center Night Vision Systems Program Office for incorporation into their efforts.

OPR: AL/CFHV, (513) 255-7592 [DSN 785]

New NVG design fits underneath issue helmet and provides improved visual acuity.

Vista Saber II

Future air battles will increasingly rely on more advanced aircraft capable of directing their weapons with greater accuracy and at larger off-boresight angles. Analysis of current threats indicate that some potential adversaries already include some of this enhanced technology in their aircraft today.

Helmet-Mounted Displays and Sights (HMD/S), combined with an agile missile, provide a capable response to that threat. These systems let the pilot lock on to targets and fire missiles at much greater angles than normally allowed in the Heads-Up Display. The HMD also provides the capability to display other important and time critical information at any head orientation. No longer will the pilot have to look inside the cockpit to determine weapon status, airspeed, altitude, or general aircraft attitude, resulting in an increase in situational awareness and combat effectiveness.

The Vista Sabre II program effort is to install two helmet-mounted displays/sights on two F-15C aircraft to demonstrate the capabilities of this technology in air-to-air combat. The Visual Display Systems Branch of the Armstrong Laboratory Crew Systems Directorate has teamed with the 57th Test Group at Nellis AFB NV and the F-15 Engineering Group at Warner-Robins AFB GA to conduct this effort. The two aircraft are being modified by McDonnell Douglas Aircraft of St Louis MO to incorporate the Kaiser Electronics Agile Eye HMD and associated display electronics. The electronics will interface with other aircraft avionics and present a see-through 20-degree field of view projected on the helmet visor graphically overlaying the line of sight of the pilot's right eye.

The HMD/S will help the pilot locate a target faster, lock a missile onto that target, and simulate the missile launch. Previous simulator studies have shown significant improvements in aircraft kill ratio. This program will demonstrate the technology during actual flight tests. During this time, the system will be evaluated through all aspects of the close-in visual combat arena.

OPR: AL/CFHV,
(513) 255-7594 [DSN 785]

Vista Saber II is a field evaluation of a Helmet-Mounted Display/Sight system.

Force Reflection Stick Controllers

As pilots are subjected to accelerations greater than 1-G, arm/hand loadings are fed through to current analog and digital (fly-by-wire) stick controllers. These severe motions can adversely affect the pilot's tracking ability. Data from high-G centrifuge tests revealed that when acceleration forces opposed the stick displacement, tracking performance improved substantially.

A test bed facility showed conclusively that reflecting a force back opposite the hand motion, based on measurements of the external acceleration, provides smoother tracking responses. Presently, a second generation stick controller is used daily by handicapped people at the St Elizabeth Hospital in Dayton OH as part of a joint Armstrong Laboratory/Veterans Administration program. This program provides an extensive database for both pilots in static and acceleration situations and disabled people who need to control their spasticity.

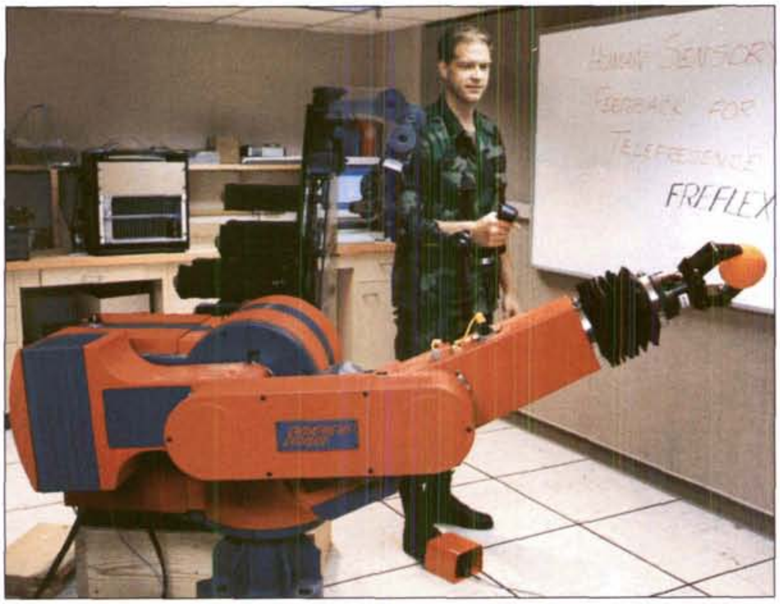
Force reflection offers great promise in manual control with applications to controllers for aircraft during the high acceleration maneuvers typical of modern agile fighters, wheelchairs, and heavy equipment operations. Any exercise involving tracking where hand or arm motion may be disturbed by the environment or induced by neuromotor disorders can be improved by force reflection controllers.

OPR: AL/CFBS, (513) 257-5742 [DSN 787]

Force reflection provides smoother tracking during random arm movements.

Force Reflection for Human Sensory Feedback

Telerobotic systems provide the capability to project human presence, cognition, and intuition into environments that would be lethal to human workers. High fidelity human-in-the-loop control of telerobotic systems requires natural intuitive feedback for the human operator. A key component to the successful operation of these remotely controlled systems is the use of force-reflection methods to give the operator the sensation of "presence" at the hazardous work sites. Natural intuitive force reflective feedback augments visual and auditory feedback in the unstructured work environment. The development of a Force REFLecting EXoskeleton (FREFLEX) has been a prime goal of the Human Sensory Feedback program.



Operator remotely controls strength with which robot picks up object.

Odetics, Inc., has developed a FREFLEX to support human sensory feedback research at the Crew Systems Directorate at Wright-Patterson AFB OH. The FREFLEX was delivered in June 1992. The system is designed to take full advantage of the human's seven degree-of-freedom shoulder, arm, and wrist movements. Data such as force reflection ratios, range of motion measurements and system encumbrances will be collected over the next three years. These data will support human factors design of the next generation of telepresence subsystems.

In addition to providing design information for master-slave telerobotic systems, this force-reflection device has applications in synthetic environments where direct interaction with simulations and virtual models are desired.

Land based applications include toxic chemical handling and environmental cleanup. Additional uses can be envisioned in nuclear, biological, or chemically contaminated environments such as post-attack cleanup in air base operations.

Space based operations include satellite refueling and servicing, as well as unstructured repair and maintenance functions.

OPR: AL/CFBA, (513) 255-3671 [DSN 785]

Active Noise Reduction

Operational testing of the HGU-55/P flier's helmet determined communications were minimally acceptable as the earcup permitted excessive background noise to be heard by the wearer. An electronic technique called noise phase reversal has been devised to significantly attenuate much of this unwanted sound, and the device has been packaged so that it does not exceed the restricted size of a helmet earcup. This technique creates an out-of-phase sonic signal that acoustically cancels noise within the earcup, thereby improving voice communication in noisy environments and reducing fatigue to the crewmember caused by the noise.

The Active Noise Reduction (ANR) system electronics are installed in the new earcup and are provided as a direct replacement for the current earcups used in existing helmets and headsets.

Prototypes were developed during an advanced development program and tested by all three services with excellent results. An engineering development test and evaluation program is ongoing.

The ANR system will reduce the number of aircrews grounded because of hearing loss, and that, in turn, should decrease the number of related compensation claims. More importantly, this program will provide the USAF and other service aircrews a system which provides greater attenuation of undesirable sound with a simultaneous increase in communications capability, reduced fatigue, and greatly improved mission effectiveness. An additional opportunity exists for use of this type of system in loud/high noise level environments on the ground, thereby further reducing legitimate medical claims for hearing loss.

OPR: HSC/YAS, (210) 536-4538 [DSN 240]

The Active Noise Reduction earcups, as installed in an aircrew helmet (HGU-55/P), will electronically reduce annoying or distracting background noise.

3-D Audio Display System

Situational awareness (SA) is critical to all aircrews. The 3-D Audio Display system has the capability to improve SA without adding any new signals to the cockpit or requiring any new skills. This is achieved by processing existing cockpit audio signals, such as radar warning receiver tones; wingman voice communications; other radio voice communications; and navigation tones, such that the crewmember hears signals which sound as if they are coming from specific locations in azimuth, elevation, and distance, i.e., a virtual 3-D auditory display. Presenting the signals in this manner takes advantage of the crewmember's natural ability to localize sound sources. This ability is demonstrated every day by people standing on a street corner determining the location of a vehicle approaching from the rear or from outside their current field of view.

Flight demonstration hardware has been developed which can generate up to four localized auditory signals simultaneously from any audio source. The 3-D Audio Display system uses a two-channel headset, and one independent earphone for each ear. The 3-D auditory cues are stabilized in space relative to the aircraft boresight and crewmember's head position. This is accomplished using the aircraft's flight or mission computer, navigation system, and a helmet-mounted head tracking system. The 3-D Audio Display system adds approximately 3 ounces to the helmet and approximately 12 pounds to the aircraft.

The flight demonstration hardware and software development have been completed. The system, with an interface control document, has been safety tested for flight test aircraft. Laboratory studies demonstrated the utility of the 3-D Audio Display system. Crewmembers using the system can locate targets with an average error of less than 10 degrees. Target acquisition times with normal visual radar warning display locations are significantly reduced using the system. Further, the system significantly enhances voice communications in all communications environments.

The 3-D Audio Display system is one technology which can increase SA without increasing aircrew workload. The increase in SA and communication capability results in improved mission effectiveness and survivability.

OPR: AL/CFB, (513) 255-3660 [DSN 785]

3-D Audio Display system increases SA without increasing workload.

Integrated Audio Technology Demonstrator

The Integrated Audio Technology Demonstrator (IATD) is a lightweight helmet in which several emerging audio technologies have been integrated for laboratory demonstration and data collection and use in high fidelity flight simulators. These technologies include active noise reduction, 3-D audio displays, advanced noise-canceling microphones, helmet-position monitoring, and a lightweight helmet shell. Two other concepts were investigated but not integrated into the final configuration. These were an ear microphone concept and a G-loss of consciousness onset monitor and warning system. These additional concepts may be integrated at a later date if their development for this application is successful. Six copies of the IATD have been fabricated to support both laboratory performance verification tests and technology demonstrations.

The IATD helmet development and laboratory performance verification have been completed. A complete battery of tests verified the helmet system's performance in high performance aircraft cockpit noise environments. The success of the laboratory studies led to flight demonstrations of the integrated IATD in the Navy/Marine T-1 AV-8B located at the Patuxent River Naval Air Station.

Voice communications significantly improved through use of the Integrated Audio Technology Demonstrator.

Performance verifications have demonstrated increased pilot performance in several critical areas. The 3-D audio display function dramatically reduced target acquisition times. Voice communications were significantly improved by both the active noise reduction headset, 3-D audio display, and advanced noise-canceling microphones. The active noise reduction headset not only provided increased comfort, but also decreased pilot fatigue.

OPR: AL/CFB, (513) 255-3660 [DSN 785]

Performance Assessment and Workload Evaluation System

Critical to piloted aircraft flight testing is the assessment of the crew station and the cockpit design in terms of the aircrew's ability to meet mission objectives. Currently, no standard process for this aspect of flight tests exists. Thus, a variety of procedures have been employed during in-flight cockpit evaluation, resulting in a lack of commonality among test beds, programs, and systems. Often data from one flight test cannot be directly compared to another, leading to duplication of effort and reduced efficiency during test. The Performance Assessment and Workload Evaluation System (PAWES) offers a new way to support weapon system test and evaluation of crew station effectiveness and operational suitability.

This effort will develop and demonstrate a proof-of-concept capability for flight testing crew stations, while assuring common evaluation measures during ground, simulation, and in-flight tests. This includes steps for planning the crewstation evaluation, selecting procedures and measures, preparing briefing materials, processing data, and reporting results in a timely manner. In addition, PAWES will provide inspectable procedures for performing over 100 types of evaluations, recommend comparable measures for evaluating specific variables, and identify tools for implementation at the test facility. These computer based tools include form and report templates, a card catalog, a dictionary, an audit trail, and a notepad. PAWES will also include data analysis tools permitting a time synchronized display of digitized video, a 3-dimensional aircraft representation, and four real time data channels. This capability will allow the evaluation team to see an integrated view of the test results and aid in analyzing data.

PAWES offers a core capability to perform structured crew station evaluations using objective methods and measures. Further, PAWES will connect databases from flight tests and ground simulation. As a side benefit, PAWES will establish a link between laboratory personnel developing new human factors evaluation methods, and flight test practitioners who employ the methods, thereby facilitating the information flow between the research, development, test and evaluation communities. PAWES is a new capability for efficient crew station evaluation that will facilitate the technical communication of flight test results among engineers, researchers, and managers. A proof-of-concept PAWES will be built and tested by the end of FY94.

OPR: AL/CFHD, (513) 255-7581 [DSN 785]

Time-synchronized integrated view of flight test data to include aircraft attitude, performance, and video data.

Acceleration Protection

The advent of high performance fighter aircraft with the capability to sustain +Gz and the resultant potential for pilot G-induced loss of consciousness (G-LOC) has resulted in a concerted effort to improve G-protection. The +Gz training of high performance aircraft pilots has been beneficial and has led to significant reductions in G-LOC-related loss of aircraft and life. Training allows pilots to experience high +Gz and improve the efficiency of their anti-G-straining maneuver (AGSM) in a controlled centrifuge environment.

The AGSM is currently the most significant G-protective factor at high G (7-9 +Gz). The standard G-suit provides passive protection to about 5.5 +Gz. To maintain vision and consciousness above 5.5 +Gz, it is necessary to increase the AGSM level of effort as +Gz increase. Thus, at 9 +Gz, the AGSM effort is near maximal in many pilots. The AGSM is very fatiguing and is a limiting factor in pilot performance in the high +Gz environment.

The fatiguing aspect of the AGSM has driven us to develop new and improved G-protective equipment and techniques to reduce the need for maximal AGSM effort during high sustained +Gz. A recent improvement in G-protection is pressure breathing during G (PBG). PBG supplements the AGSM and can improve +Gz endurance during high +Gz by over 100 percent, compared to the combined protection of the standard G-suit and the AGSM. Combined Advanced Technology Enhanced Design G-Ensemble (COMBAT EDGE) incorporates PBG and is being retrofitted into high-performance aircraft at this time. An extended coverage anti-G suit called Advanced Technology Anti-G Suit (ATAGS) is also under development.

Investigation of the physiologic effect of G-protective equipment and techniques is a large portion of our research effort. It is important to understand the mechanism of +Gz protection and the margin of safety. Areas under investigation are (1) the effect of G-layoff (time away from the cockpit) on +Gz-tolerance; (2) a comparison of female/male G-tolerance/endurance during high +Gz and the influence of the menstrual cycle on female G-tolerance/endurance; (3) the physiologic interrelationship between blood pressure, intrathoracic pressure, the AGSM, PBG, and anti-G suit inflation during high levels of +Gz; and (4) man's upper limit of +Gz-tolerance as influenced by seat back angle, COMBAT EDGE, and ATAGS.

Our acceleration protection program is designed to provide the maximum +Gz protection, with a margin of safety, for pilot operational performance.

OPR: AL/CFTF, (210) 536-3521 [DSN 240]

Advanced +Gz-protection, illustrating the newly introduced pressure breathing system (COMBAT EDGE) and the advanced technology anti-G suit (ATAGS).

Workload Evaluation Tools

Objective measures of crewmember workload are needed for test and evaluation, design evaluation, and metric development programs. The increased complexity of modern USAF systems places higher mental workload demands upon USAF personnel. In some cases the limiting factor for new systems may be the human component. In order to design systems that can be used effectively, the mental workload placed upon the crewmembers must be measured, and systems that take human capabilities into consideration must be designed.

Traditionally, subjective measures have been used to measure operator workload, but these methods have shortcomings and need to be augmented. Measuring operator response can provide such data with heart rate, eye blinks, and brain activity acting as useful measures of cognitive activity. The Psychophysiological Assessment Test System (PATS) and the Workload Assessment Monitor (WAM) have been developed as tools to measure these signs of workload. PATS collects physiological data, stores it, reduces it, does statistical analysis, and provides many editing and analysis features. WAM provides on-line analysis of heart rate, eye blinks, and respiration. Thus, an operator's physiological state can be continuously monitored in real time and this information can be fed back to the system and evaluated by testing personnel.

Both PATS and WAM are designed to function in laboratory and simulator environments and can be used to analyze flight recorded data. Government, industry, and academic institutions have shown interest in both systems. Since they are general purpose in nature, they can fill the needs of a number of programs while meeting current USAF needs for workload measurement.

OPR: AL/CFHP, (513) 255-8748 [DSN 785]

PATS collects data which can be used to reduce aircrew mental workload.

Crew-Centered Cockpit Design Project

Air operations depend on the aircrew's ability to employ all the capabilities of the weapon system. However, aircrew tasks are becoming increasingly complex and time constrained, and are often nearing the limits of the aircrew's ability to perform all required tasks. To meet this challenge, the Crew-Centered Cockpit Design (CCCD) project has formed an interdisciplinary team to develop a new cockpit design process that is centered around crew capabilities and mission effectiveness. This process is intended for use by the aerospace industry, but is adaptable for Government oversight of the system development, and for related technology development in the DOD Laboratories.

The main products of the CCCD development are its highly disciplined process for cockpit design and a complete set of support tools and technology that will help to make the process efficient. The process spans all phases of systems acquisition from concept exploration through production and deployment. It identifies and organizes each engineering design activity, while managing the flow of engineering data produced at each step. The supporting tools and technology are embodied within a Cockpit Design System (CDS), which is a self-contained design support system providing full-time support for crew-system engineering from start to finish. Included is an integrated set of cockpit analysis software, computer-aided design software for cockpit layout, database management tools for engineering data, and a real time cockpit simulator that is configurable in hardware and software for test and evaluation. The CDS computer software also affords the cockpit design team a complete and up-to-date picture of development status and work remaining, thereby serving a dual role for project management and engineering support. CCCD represents a new capability for human systems integration, correcting recognized shortcomings in the current design practice. An initial version of the CCCD design process and a full-scale functioning prototype of the CDS have been delivered and are undergoing checkout for validation and demonstration.

For the first time, the crew system can be developed using a proven process and integrated computer based tools producing a well documented, tested, and traceable design that is tied to mission requirements. Cockpit design and testing can start much earlier in the development cycle, thereby reducing cost and risk while improving operability. By designing the cockpit with crew capabilities as the central focus, CCCD can maximize the aircrew's capability to fly, fight, and win.

Engineers evaluate subject's workload response to cockpit design.

OPR: AL/CFHD, (513) 255-8860
[DSN 785]

Computer-Aided Systems Human Engineering: Performance Visualization System

Research and development efforts in the Design Technology Laboratory are significantly advancing the state of the art in design visualization technologies and preparing to transition those technologies into the USAF and civilian design communities. Armstrong Laboratory, leading a consortium of government organizations consisting of the Federal Aviation Administration; the Defense Technical Information Center; NATO Advisory Group for Aerospace Research and Development; the Army's Human Engineering Laboratory; the Naval Command, Control, and Surveillance Center; and the Air Force Office of Scientific Research is developing the Computer-Aided Systems Human Engineering: Performance Visualization System (CASHE:PVS).

The Computer-Aided Systems Human Engineering: Performance Visualization System (CASHE:PVS) will offer crew systems designers computerized hyperlinked access to over 1,150 entries on human perception and performance data.

CASHE:PVS version 1.0 is a CD-ROM-based hypermedia-ergonomic information base which will provide crew system designers ready and intuitive access to on-line graphical and textual human perception and performance data. Tightly coupled with this information base are sets of interactive software "test benches" which will provide designers with performance visualization capabilities to enhance their ability to analyze, explore, and apply human behavioral data to specific equipment designs. The CASHE:PVS version 1.0 will be available during the second quarter of FY94. A new contract start in the human performance and perceptual design visualization system will field test the version 1.0 software in actual design environments and will begin the development of a subsequent version for supporting collaborative design in Computer-Aided Design (CAD) and Computer-Aided Engineering (CAE) environments.

As a precursor to developing collaborative design technology, an in-depth study of actual USAF design teams has been completed. Human factors branch team members from Aeronautical Systems Center at Wright-Patterson AFB OH, were interviewed using the in-house developed knowledge engineering tools, Concept Mapper and Concept Interpreter, to explore design as currently practiced in the crew system acquisition process. This collaborative design knowledge acquisition is the beginning of a framework for the development of advanced group centered design tools.

OPR: AL/CFH, (513) 255-8805 [DSN 785]

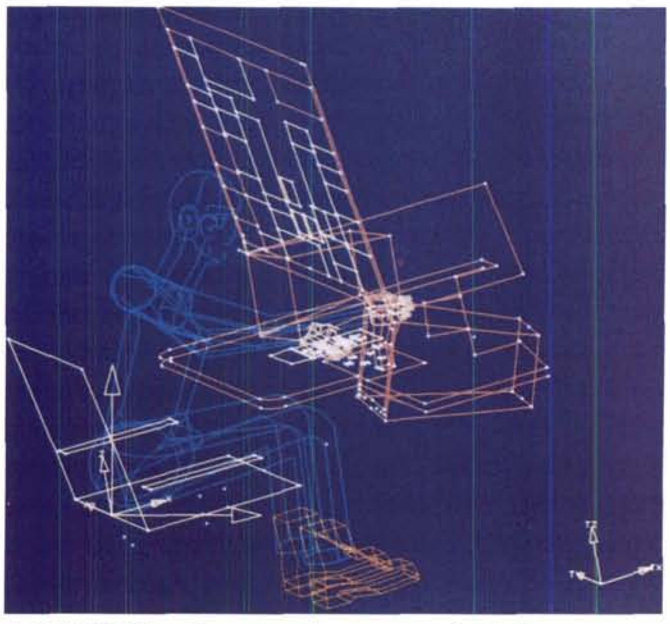
Computerized Biomechanical Man-Model

Early identification of potential design-induced operator accommodation problems is essential in order to correct a problem before mockup, fabrication, or production. To facilitate early identification of design problems, Human Systems Center's Human Engineering Division is developing Computerized Biomechanical Man-Model (COMBIMAN), a Computer-Aided Design (CAD) model of an aircraft pilot which allows the designer to perform the functions of an expert ergonomist. The designer may simulate an operator activity on the computer-generated image to determine if the activity is physically possible. Expert system software automatically creates the correct body size and proportions for male and female pilots, the encumbrance of clothing, personal protective equipment, and mobility. Expert system task analysis is available for reaching controls, visual access, and strength.

Version 9 of COMBIMAN was completed in 1992. It incorporates several databases, functional capability for 1st to 99th percentile male and female dimensions, and six flight clothing types. Automated task analyses include reach, vision, and strength analyses. The model computes strength for operating all types of vehicle controls (wheels, levers, pedals, etc.). Visibility shows the vehicle from the operator's viewpoint including controls, displays, windows, and even objects outside the vehicle. COMBIMAN's uniquely automated arm and leg reach and reach envelopes take into consideration the encumbrance of clothing and harness.

The COMBIMAN model will reduce the incidence of accommodation problems by allowing the designer to perform analyses and correct design related defects. Ultimately, not only will development engineering costs and acquisition time be reduced by doing it right the first time, but system performance will increase. COMBIMAN is interfaced directly with several popular commercial computer-aided design systems so the design itself can be used as an electronic mockup. Because the interface is direct, no file transfer or conversion is required prior to the evaluation. COMBIMAN software and analysis capabilities are now available to US businesses through the Crew System Ergonomics Information Analysis Center known as CSERIAC.

OPR: AL/CFHD, (513) 255-2558 [DSN 785]



COMBIMAN evaluates reach to a control grip in a navigator's crew station.

Advanced Dynamic Anthropomorphic Manikin (ADAM)

Armstrong Laboratory developed the Advanced Dynamic Anthropomorphic Manikin (ADAM) for use in testing escape systems and crew protection systems. Manikin development was initiated in 1985 to support the Crew Escape Technologies (CREST) advanced ejection seat program and has resulted in the fabrication of five small and five large manikins. The manikin design provides a human-like reactive load into the ejection seat and possesses realistic dynamics and kinematics during windblast, impact, vibration, and acceleration forces encountered during ejection.

ADAM was used in rocket sled tests to demonstrate "his" capability for ejection seat testing at speeds up to 700 miles per hour. ADAM was also used by Project PULL (Parachute Understanding Loads and Logistics) to develop a free fall parachute opening shock database for establishing potential injury criteria of parachute opening shock and ground impact loading.

Current emphasis is on developing a manikin-based injury assessment capability and corresponding ADAM refinements, including upgrading the ADAM data acquisition system. Composite materials have also been developed for use in manikin body segments resulting in a higher strength-to-weight ratio, more bone-like deformation properties, and more human-like inertial distribution properties than metal manikin segments. A prototype manikin leg has been fabricated with force sensors embedded directly in the composite material during production. This capability will provide researchers with information on forces transmitted through the leg segments during aircraft ejection. Further improvements include the development of an improved manikin neck structure adaptable to existing test manikins. It will provide a more human-like response than currently available manikin necks and will serve as a test and evaluation tool for head-mounted devices, protection equipment, and ejection systems.

ADAM will be a powerful test and evaluation tool for assessing ejection seat performance and crewmember protection. Its design provides for human-like reactive loading into the ejection seat and measurements on a variety of body, seat, and protection system responses. The ADAM data acquisition upgrade has been completed, and acceptance tests involving vertical and horizontal impacts were performed. Environmental tests of upgraded ADAM were completed in September 1992, and rocket sled ejection tests resumed in November 1992.

OPR: AL/CFB, (513) 255-3665 [DSN 785]

ADAM skydiving -- determination of parachute-opening shock criteria.

Near-Threshold Processing of Visual Stimuli

The Air Combat Command has been interested in the dynamics of pilot situational awareness (SA) since the 1980's. We now know that SA is an elusive, yet important concept, and its attainment is rooted in our human information processing capabilities. It is an ability which changes over time; pilots often claim their SA was "shut up in the map case," just out of reach, on a particular mission.

Researchers at the Armstrong Laboratory are targeting a component of SA known as "Near-Threshold Processing of Visual Stimuli," and testing two related theories. One theory is that pilots can be trained to recognize and identify objects in their environment presented for short durations (33-67 milliseconds). Pilot selectee ROTC students successfully demonstrated this training in two studies using identification of familiar playing card suit symbols. The second theory being tested is that there may be a basic ability to recognize and identify fleeting stimuli that separate top performing pilots from "average performers." Initial studies show that subjects differ widely in their performance of these tasks, but determining whether these subjects also differ in flight performance or ability to attain and maintain SA is our major goal. Neither of these theories have meaning to the USAF unless fleeting recognition skills correlate with superior SA in the cockpit. A special team, the Situational Awareness Integration Team (SAINT), was formed to coordinate Armstrong Laboratory efforts. A SAINT study using fighter pilots was completed in the fall of 1992 to try to establish the connection between near-threshold visual processing skills and operational SA.

Software has been developed to use operationally relevant symbols to test these selection and training premises. The current version uses a three-dimensional Silicon Graphics system with realistic computer-generated aircraft models and varying backgrounds. It tests pilots' abilities and gauges their performance improvement in the task. Future software will display targets in a dynamic mode, and the computer screen will emulate a moving cockpit's windscreen. If this system proves to be a valid measure for visual stimuli processing, it will be used as part of a computerized task battery for selecting pilot training candidates or in classifying students into fighter or tanker/transport/bomber tracks. Pilots might also use the system to hone this component of SA before a mission.

OPR: AL/CFTO, (210) 536-3464 [DSN 240]

A subject in an enclosure custom built for situational awareness research responds to a fleeting aircraft symbol.

Burn Prediction Model: Burn Simulator

Exposure to extreme thermal environments such as a fire, atomic flash, or aerothermal heating during emergency escape at high Mach will result in skin burns if protective measures are inadequate. BURNSIM is a computer model allowing the user to predict burn hazards. Originally written to run on minicomputers, it has been rewritten to run on more readily available personal computers (PC). Further, a module has been added to account for the insulation provided by protective clothing.

For the past two years, the Escape and Impact Protection Branch of the Crew Systems Directorate at Wright-Patterson AFB OH has been developing a PC version of BURNSIM and a clothing module for standard military clothing. In 1991, the PC version of BURNSIM was given to more than 30 users at the 2nd Annual Human Response Program Technology Transfer meeting.

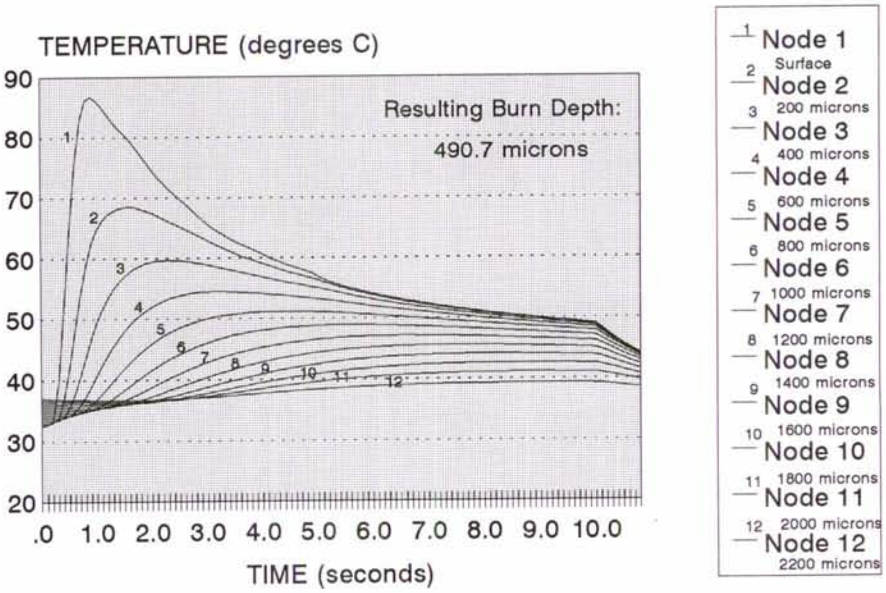
Two approaches to the clothing module have been developed. The first is an analytical solution requiring detailed knowledge of the properties and dimensions of the layers of the ensemble. The second, treats the ensemble as a lumped filter. The final clothing module will be selected, interfaced with BURNSIM, and validated over the next two years.

In addition to providing a tool for assessing the risk of burn injury for troops exposed to nuclear flash, BURNSIM has an application for conducting design studies to optimize the protective ensembles for hypervelocity vehicle crews.

Land based applications will include designing firefighters' protective clothing, foundry workers' clothing, and burn risk assessment associated with live fire studies of military systems.

Space based operations will also require a burn hazard assessment of injury causes.

OPR: AL/CFB, (513) 255-3931 [DSN 785]



Output of BURNSIM model predicts severity of skin burn.

Aircraft Windscreen Field Measurement Device: Haze-o-Meter II

The majority of military aircraft windscreens are made out of tough plastic to minimize the possibility of the windscreen shattering. However, the switch from glass to plastic has caused several phenomena which can impact the optical quality of the transparency. One of these phenomena is haze, which is caused by the scattering of light from materials (interlayers) within the windscreen and from tiny scratches on the surface of the relatively soft plastic.

At the request of the Windscreen System Program Office, a field usable measurement device has been developed to determine both the severity of haze (without removing the windscreen from the aircraft) and the correct time to repair the windscreen because of haze. Since haze scatters light backward (toward the light source) as well as forward, a single device can house both the test light source and the light detection system necessary to make the measurement. Furthermore, the device can be calibrated in such a way that the haze readings are nearly identical with the measurements obtained by removing the windscreen and testing it in the laboratory. Armstrong Laboratory researchers have patented the device called Haze-o-Meter II.

Haze-o-Meter II being used to measure F-15 canopy during device field test at Eglin AFB FL.

The Haze-o-Meter II was field tested in the summer of 1992 at Eglin AFB FL on an F-15 windscreen which had been in service for about 18 months. It performed well and is undergoing further improvement to make it easily usable by maintenance personnel.

OPR: AL/CFHV, (513) 255-8816 [DSN 785]

Spatial Disorientation Countermeasures

Spatial disorientation (SD) remains one of the leading causes of fatal aircraft accidents in the USAF. The improved capability of modern weapon systems to operate at night and in other conditions of degraded visibility creates situations especially conducive to SD; and increasing reliance on low-level maneuvering in combat tactics reduces the margin for error when SD does occur. Solutions to the SD problem are being sought in a three-pronged research and development attack: (1) improve our understanding of the mechanisms of spatial orientation and disorientation, (2) develop training methods that help pilots either resist or cope with SD, and (3) develop flight instrument displays that improve pilots' ability to maintain accurate spatial orientation.

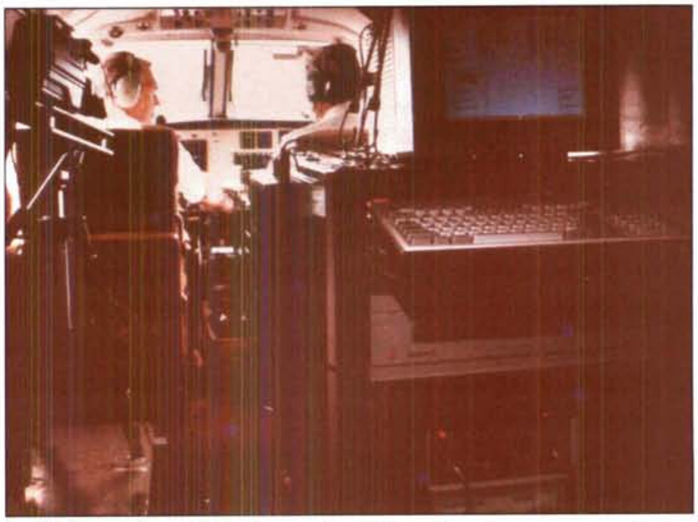
The Visual Orientation Laboratory generated strong evidence supporting a new theory of the three-dimensional nature of visual attention--visual research and object recognition is most efficient in the upper right quadrant of the visual field. Additional work showing different effects of wide- and narrow-field-of-view background scenes on postural stability and manual control was completed. Both of these studies helped develop important concepts for efficient presentation of visual information on flight instrument displays. Research quantifying the "G-excess" form of SD was completed on the Dynamic Environment Simulator. Illusory vehicle tilts of 10 degrees were demonstrated when subjects' heads were tilted during exposure to G-levels up to +4 Gz. This finding helps explain why pilots tend to overbank their aircraft and inadvertently descend while looking out of the cockpit during sustained turns.

The Advanced Spatial Disorientation Demonstrator (ASDD) was delivered to the Armstrong Laboratory and the USAF School of Aerospace Medicine. This device will demonstrate to pilot trainees both visual and vestibular forms of SD in a special purpose flight simulator. Training methods for use with the ASDD will be developed and transitioned to Air Education and Training Command and Air Combat Command.

Flight instrument display research continued in two areas: head-up display (HUD) symbology and acoustic orientation. After evaluating competing HUD primary flight symbology elements, researchers provided the Joint Cockpit Office with optimally performing elements of a proposed USAF standard HUD symbology suite. Results of earlier flight-testing of a prototype Acoustic Orientation Instrument were analyzed, and laboratory refinement of candidate acoustic signals for airspeed, vertical velocity, and bank angle was accomplished.

SD Countermeasures research will improve the operational effectiveness of our weapon systems and reduce the drain on USAF resources resulting from SD-related aircraft mishaps.

OPR: AL/CFTF, (210) 536-3521 [DSN 240]



In-flight testing of the Acoustic Orientation Instrument, which provides an auditory display of bank angle, vertical velocity, and airspeed.

Personal Computer Software System for Crewmember Ejection and Crash Analysis

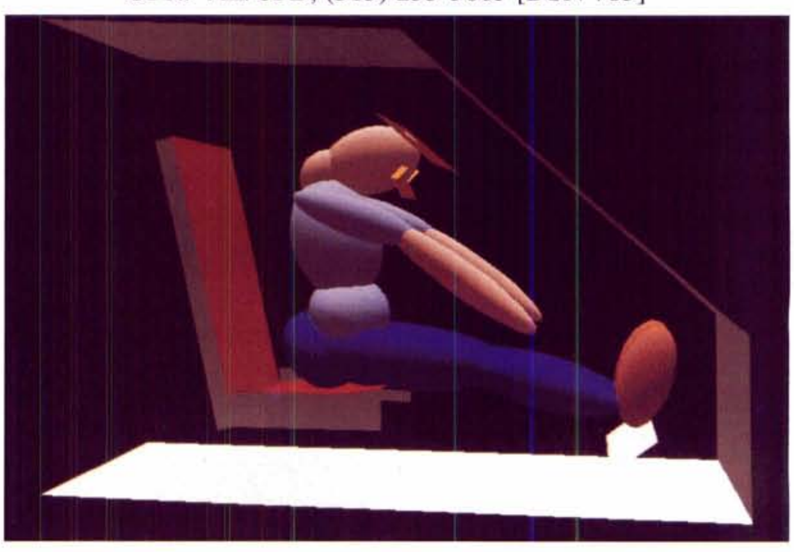
The Articulated Total Body (ATB) model is a computer simulation program developed by the Armstrong Laboratory (AL) for predicting human body dynamics during aircraft ejection, crashes, and other hazardous events. It is based on the Crash Victim Simulator developed by the National Highway Traffic Safety Administration (NHTSA) during the early 1970's. Its ability to predict internal and external responses of the human body, manikins, seats, and other structures, makes the ATB model broadly applicable in the automobile, aerospace, and other transportation communities. Recently, under a Small Business Innovation Research (SBIR) effort, the model has been installed on microcomputers, easing accessibility to a wider variety of users.

The ATB model has been used to determine the safety of proposed structures in the aircraft cockpit before prototypes were built or costly tests conducted. It has also been used to provide data that cannot be measured during a test, such as forces within the body, and to supplement test data through the ability to vary the parameters of the simulations.

The ATB model is used to test theories on the events during an accident and the cause of injury. It is also used to test the effects of design changes on safety before prototypes are built and costly tests are conducted. The model is also widely used in the civilian sector for improving consumer safety in the automobile industry. It is ideally suited for the commercial sector because it is applicable to many dynamic systems and can be used on different computer systems. Individuals investigating automobile accidents, developing restraint systems, studying human motion in any dynamic environment or interested in other dynamic systems can use the ATB model for their analysis.

The Phase II Small Business Innovative Research contract to install the ATB model on a microcomputer and develop a complete software package for improving its user-friendliness ended in October 1992. This package, named DYNAMAN, includes a user-friendly preprocessor for developing the simulation database, the ATB model, and a postprocessor for plotting the simulated body motion and graphing time history results. DYNAMAN operates on microcomputers running under DOS and on Silicon Graphics workstations.

OPR: AL/CFB, (513) 255-3665 [DSN 785]



ATB simulation of a crewmember during a cargo plane crash landing, studying head impact with head-up display.

Live Fire Testing and Human Vulnerability Assessment Methodology

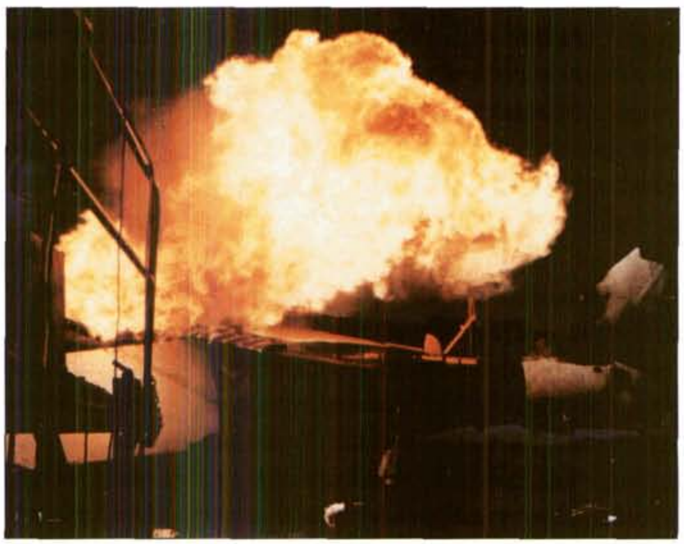
In 1986 the United States Congress passed a law requiring all major weapon systems be tested for vulnerability and lethality. The tests were to place special emphasis on personnel casualties. This statute led to development of the Joint Live Fire Test program. Armstrong Laboratory's program assesses potential threats that may incapacitate aircraft personnel. It assesses the impact on aircrew of penetrating injuries from fragments, burn injuries from fires and explosions, toxicological effects from combustion gases, and hearing loss and organ damage from blast overpressures. Measurements are taken during realistic combat environment simulations which are produced in a highly sophisticated firing range with state-of-the-art instrumentation. A unique product of this research is a fragment capture manikin called Aerospace Incapacitation Response Manikin (AIRMAN), a spin-off technology from the NASA shuttle program.

Live-fire tests simulate controlled battlefield conditions, so the researcher can obtain accurate descriptions of the environment behind defeated armor on weapon systems. Information obtained from these tests helps predict the pilots' ability to successfully complete their missions. To collect data needed to determine the environment a pilot is exposed to, a variety of heat, pressure, and gas sensors are placed on the AIRMAN manikin and the manikin is placed in a full-scale aircraft crew station. A specially designed gun fires a predetermined size round into the crew station, and researchers analyze data from the sensors. Fragments that would hit the pilot are captured by the manikin. These data determine the injury a real human might receive, and conclusions are drawn on the pilot's ability to complete the mission.

Information obtained from live fire tests will establish standards for the design, development, and acquisition of future aircraft weapon systems and aircrew personal protective equipment. This information will provide understanding of combat injuries aircrew may receive from future threats. The live-fire test data can also be used to develop realistic computer simulations for training.

The F-15 Live Fire Test was completed in May 1991 and provided valuable information on human vulnerability which is the cornerstone of our research. The biological assessment of AIRMAN F-15 Live Fire Test data is being evaluated by the US Army Ballistic Research Lab using their "Computerman" wound simulator. To improve upon AIRMAN measurement techniques, a program to develop a computer-aided measurements system was initiated. This system will provide accurate, consistent, and user friendly analysis of AIRMAN data.

OPR: AL/CFB, (513) 255-5963 [DSN 785]



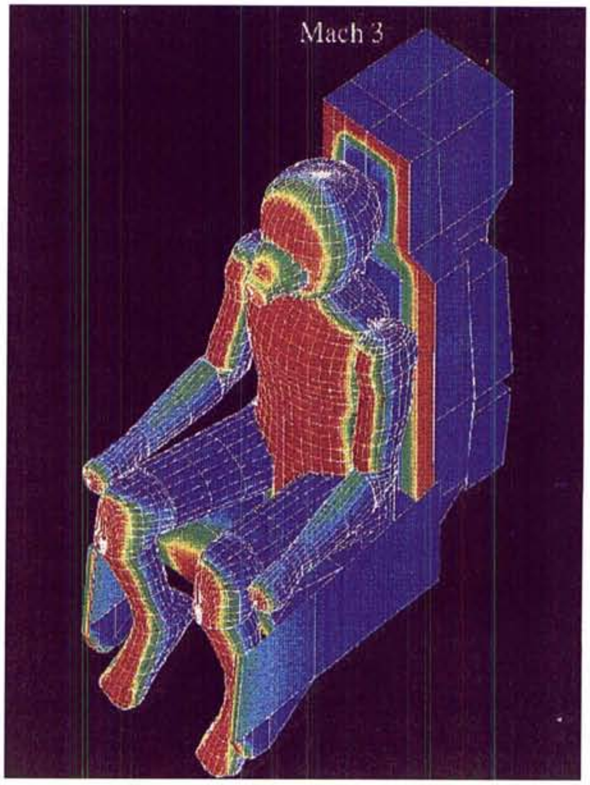
Full-scale live fire test for assessing crewmember vulnerability.

Hypersonic Flight Crew Escape

The Hypersonic Flight Crew Escape effort will provide the design criteria and evaluation techniques necessary to increase crew survivability during emergency egress from hypervelocity flight vehicles. Initial efforts will define ejection seat performance envelope limits due to aerodynamic and thermal loads acting on the crewmember, and build human systems technology required to develop advanced enclosed escape systems for crew protection at hypervelocity speeds. Existing test data will be analyzed to develop methodology for balancing the inertial and aerodynamic forces acting on the human body during emergency escape and to determine the burn injury potential from transient thermal exposure. These analyses will help to define the Mach limit of ejection seats and provide analytical methods and criteria required to maximize performance and develop or modify personnel protection systems. Advanced development programs will investigate the heat transfer characteristics of proposed pressure suit materials. Subsequent efforts will focus on human systems' issues associated with hypervelocity escape system concepts using separable forebodies. These issues involve developing human tolerance criteria for transient multi axial and long duration oscillatory accelerations.

A study contract was awarded to McDonnell Douglas Missile Systems in 1991. This study provided the design concepts, analytical tools, and evaluation methods that will be used in the development of crew escape systems for the X-30 and subsequent generations of manned transatmospheric vehicles. The escape simulations conducted have highlighted the need to advance specific key aeromedical technologies to enable the successful development of hypervelocity escape systems. The results of this concept study will be applied to the development of future hypersonic aerospace vehicles.

OPR: AL/CFB, (513) 255-3122 [DSN 785]



Predicted Pressure Coefficient on the Crew Escape Technology Seat, Mach 3.

Helmet Visual Display System

Unique Helmet-Mounted Displays (HMD) are being developed to meet specific user needs. Cooperative efforts with the US Army, Rome Laboratory, and Wright Laboratory have maintained direct user interface in our helmet display optics development activities. One such user-specific device under development is the bi-catadioptric helmet-mounted display (BI-CAT HMD) system.

The BI-CAT is based on bi-catadioptric lenses and provides a color-corrected, 50-degree, fully overlapped, binocular field of view with a very large 19-millimeter exit pupil for ease of use. The display mounts to a HGU-56 helmet and includes interpupillary adjustment. To allow for the future, it incorporates newly used tangent (theta) optics mapping to permit its direct use with advanced miniature LCD color image sources as they become available. Development of a new miniature cathode ray tube with a 23-millimeter active format area made it possible to achieve excellent performance.

Two BI-CAT HMD systems will be delivered to the Army for testing in a Blackhawk helicopter as part of a joint NASA/ US Army flight test. Rome Laboratory and Wright Laboratory will also take delivery of systems for use in their simulation work. Other advanced HMD optical systems are in preliminary design to meet specific user requirements and to feed into the Helmet-Mounted Systems Technology Advanced Development Program Office efforts.

OPR: AL/CFHV, (513) 255-8904 [DSN 785]

Helmet-Mounted Displays such as "BI-CAT" must be tailored for specific user needs.

Human Resources

This Human Systems Center product area accomplishes research and develops, fields, and supports unique Manpower, Personnel, and Training technology and systems.

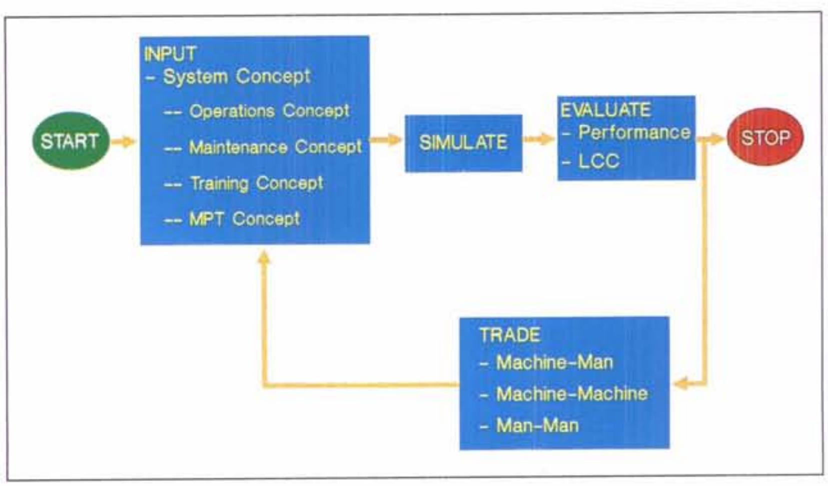
Weapon System Optimization Model

The USAF weapon system acquisition process requires weapon system life cycle cost and performance criteria to evaluate the emerging weapon system during design and development. Manpower, personnel, and training (MPT) factors must also be considered at the design phase. Major command (MAJCOM) planning shops and MPT Planning Team members need a model to consider tradeoffs among weapon system characteristics, maintenance, and logistic concepts; MPT factors; and performance/cost parameters. The Weapon System Optimization Model (SYSMOD) will integrate MPT issues into the early weapon system design process.

Front-end analysis for SYSMOD development was completed in 1991, resulting in a conceptual research and development plan and a demonstration model for user feedback. Input/output variables were identified and system specifications developed. The prototype SYSMOD will be a personal computer based user-friendly information management system needing minimal user knowledge to operate. SYSMOD will take into account not only MPT requirements, but also organizational structure, maintenance, and operational concepts, and sortie requirements. Follow-on efforts will include necessary model refinements to interface SYSMOD with the MPT Decision Support System, which will provide MPT analysts a tool for use in post-Milestone I weapon system acquisition analysis.

SYSMOD will provide MPT Planning Team members and MAJCOM planning personnel with the integrated tool they need to develop early MPT criteria for weapon system design. It will provide concrete data for cost vs performance tradeoffs to optimize weapon system operation and maintenance support.

OPR: AL/HRM, (210) 536-3648 [DSN 240]



SYSMOD integrates MPT issues early in the design process

Learning Abilities Measurement Program

USAF personnel work in highly technical environments. The challenge is to identify individuals most likely to succeed in these environments. Recent developments in personnel assessment technology promise to enhance the selection and training of our personnel. The Learning Abilities Measurement Program (LAMP) is a basic research effort to identify learning abilities using computer based aptitude assessment technology. Information processing tests delivered on microcomputers measure abilities not captured by traditional written tests and bring increased flexibility, comprehensiveness, and utility to personnel selection and training.

LAMP scientists developed and refined the Cognitive Abilities Measurement (CAM) battery. The CAM measures such abilities as processing speed and capacity, and when used in conjunction with the Armed Services Vocational Aptitude Battery will improve the ability to predict training success. We validated the improved prediction capability of CAM in the areas of computer programming, basic electricity, and flight engineering.

Presently LAMP scientists are investigating new abilities such as speed-distance estimation, multi-model (auditory versus visual), and perceptual motor processing. We will relate these abilities to the acquisition of basic flying skills using the Basic Flight Instruction Tutoring System which yields a detailed quantitative record of learning performance.

LAMP scientists also collaborated with aircrew selection and classification experts to develop a Situational Awareness Aptitude Battery. The goal is to identify pilots who develop the highest degree of situational awareness in flying combat missions. In the near future, scientists will develop performance assessment batteries to evaluate the effects of unusual environments (e.g., space), disruptive, stressful environments (e.g., cockpit, control tower), and medical conditions (e.g., drugged state) on thinking, learning, and problem solving ability.

LAMP results indicate that assessment technology can improve the current selection and classification system. These improvements will reduce training costs and enhance training procedures and performance measures.

The Basic Flight Instruction Tutoring System (BFITS) teaches flying skills and records performance data.

OPR: AL/HRM, (210) 536-3876 [DSN 240]

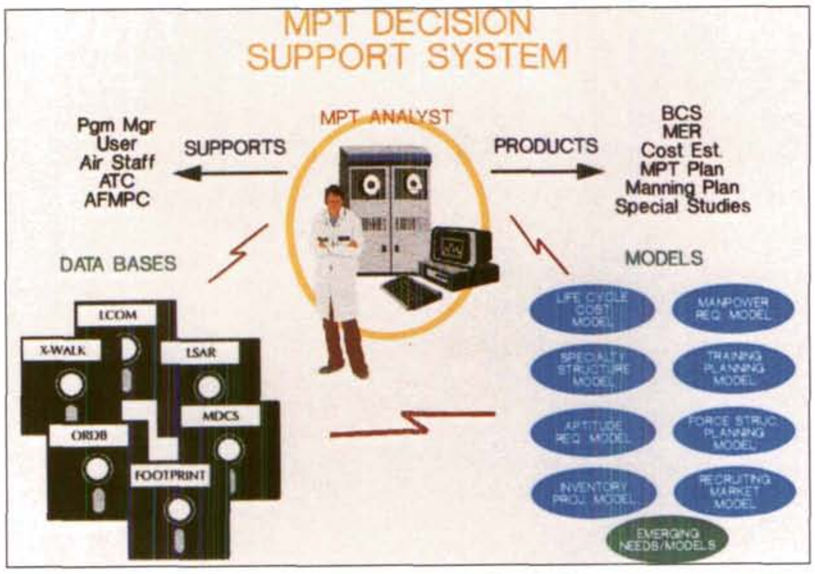
Manpower, Personnel and Training Decision Support System

Manpower, personnel, and training (MPT) issues are integral to weapon system operation and performance, and account for about half of the life cycle cost. At this time there is no effective process to account for MPT issues during weapon system design and acquisition. The MPT Decision Support System (DSS) will provide an integrated software system to permit up-front estimation of MPT requirements during weapon system development. It will also enable tradeoff analyses and allow validation that emerging designs meet MPT constraints. In addition, it will provide planners with information needed to set up personnel acquisition and training pipelines.

The MPT DSS builds on technology developed for the USAF Integrated Manpower, Personnel, and Comprehensive Training and Safety, known as IMPACTS, program. Databases have been developed and integrated, and procedures developed for database linkage, tradeoff analyses, and automated instructional system development. The MPT DSS will be complete in 1996.

Integrating MPT tradeoffs early in the weapon systems acquisition will reduce cost, improve weapon system supportability, and maximize combat readiness. MPT DSS will ensure the USAF meets operational requirements despite reduced MPT resources and shorten the time between system delivery and full operational capability.

OPR: AL/HRM, (210) 536-3648 [DSN 240]



MPT DSS Model analyses up-front MPT tradeoffs during weapon system development.

Productivity Capacity Project

USAF enlistment standards are continuously evaluated and raised or lowered, as necessary, to ensure recruits have the aptitude to successfully complete technical training. With the force size shrinking and competition for high-quality personnel increasing, Congress and DOD are scrutinizing standards closely to assure adequate linkage not only to training outcomes, but also to later actual job performance.

Exploration of alternate measures of job performance to serve as criteria has become a priority research topic. Accurate and fair measures are essential. Further, performance measures must be "user friendly" to enable operational managers to specify their minimum job requirements precisely and easily.

Productive capacity is one of the innovative scales being studied. It reflects the amount of work per unit of time an individual could produce, relative to the most productive member of that USAF specialty. Hands-on tests of job tasks are set up in the workplace, then actual times are recorded for enlisted personnel to satisfactorily complete the tasks. Supervisors are also participating to determine if they can give accurate estimates of the productive capacity of their employees. A major research interest is whether the less costly supervisor estimate can be substituted for the labor-intensive hands-on test.

During the initial field tryout, researchers collected data on 600 airmen in four Air Force Specialties: Aircrew Life Support (122XO), Aerospace Ground Equipment (454X1), Avionics Communication and Navigation (455X2), and Personnel (732X0). Preliminary results were encouraging, and productive capacity measurement in additional jobs is underway.

The most immediate and important application of productive capacity research focuses on setting enlistment standards for optimal selection and classification of USAF personnel. The measures also have potential value in evaluating the impact of personnel policies, such as the force structure and training practices on job performance.

OPR: AL/HRM, (210) 536-3942 [DSN 240]

An avionics specialist is timed and evaluated as he performs a task in the hands-on performance test.

Pilot Candidate Selection Method

The identification of candidates most likely to succeed as USAF pilots is a key USAF goal. The maneuverability and complexity of USAF aircraft demand exceptional physical condition, psychomotor coordination, and cognitive abilities. The Pilot Candidate Selection Method (PCSM) is a system which will combine computer based Basic Attributes Test (BAT) scores with more conventional paper/pencil tests to obtain a prediction of candidate performance in Undergraduate Pilot Training (UPT). UPT attrition rates have been well above 20 percent over the last several years. PCSM will fill the existing requirement to improve the current selection procedures.

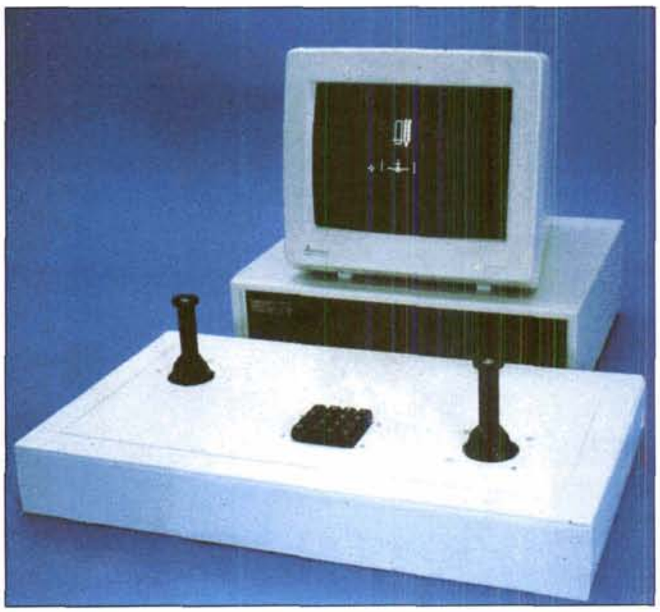
The BAT battery consists of six computerized tests that assess individual differences in psychomotor coordination, information processing ability, and personality. The BAT also includes a short biographical section which records the subject's age, previous flying experience, and other data.

Related efforts include a project to tie situational awareness in fighter pilots to computer administered tests, and a test battery developed in collaboration with the Euro-NATO Aircrew Selection Working Group. European selectees for the Euro-NATO Joint Jet Pilot Training (ENJJPT) program at Sheppard AFB will be assessed using the BAT and tracked through the program.

BAT stations were developed by the Human Systems Program Office and deployed at over 100 training sites throughout the USAF. A test processing station was also installed at Air Force Military Personnel Center to automatically receive and process BAT scores from the USAF training sites.

Payoffs from using PCSM include high-quality pilot candidates, reduced attrition, decreased training costs, optimal assignment, increased job satisfaction, and improved retention.

OPR: HSC/YAR, (210) 536-2477
AL/HRM, (210) 536-3942
[DSN 240]



PCSM system evaluates aptitude of undergraduate pilot candidates.

Job Design System

The military has entered a period of rapidly shrinking resources. The USAF needs to broaden many current job boundaries, create "generalists" rather than "specialists," and consolidate job categories into a smaller number of specialties. Complex rearrangements of duties are needed in certain job areas because of advancing technologies and new deployment concepts. Most research in the past has been directed toward matching people to existing jobs or specialties. The current research is aimed at defining the requirements of new or hypothetical specialties that might result from an extensive classification restructure.

A Job Design System is being developed to address these problems. Job requirement technologies being researched include procedures for identifying, describing, and measuring the characteristics of people and jobs. Examples include the physical demands and learning difficulty of tasks and jobs; the knowledge, skills, and attributes needed for successful job performance; and the aptitudes and technical training required for entering specialties.

Technologies that address the transferability of skills are being developed and include research of methods for estimating retraining times, job learning difficulty, and ease of movement for personnel changing from one job to another. Restructuring methods include engineering approaches to job design based on time studies; workflow analysis, and various efficiency measures; participative approaches involving employee working groups and quality circles; and modeling approaches that simulate the effects of a given job structure.

The Job Design System will be applicable to other services and agencies within the DOD and to other agencies that manage a large number of people across multiple job classifications. Under the Project TAPSTEM initiative, the Army Research Institute is sending research scientists to work in Armstrong Laboratory Human Resources Directorate, Job Structure Branch to address related issues.

OPR: AL/HRM, (210) 536-3256 [DSN 240]

Scientists are working to increase the speed with which occupational analysis data can be collected and analyzed.

The Automated Personnel Testing Program

In order to guarantee that the best qualified individuals are selected by the USAF, it is essential that the most current approaches to identifying learning abilities and sophisticated measurement be used for selection and classification. In the recent past, significant advances have occurred in the psychological theory of the underlying abilities related to training and job performance and in the technology available to measure these abilities.

The Automated Personnel Testing project (APT) is a recent initiative designed to evaluate the utility of computerized selection and classification instruments. This will be accomplished by examining the validity of the tests in predicting performance in technical training. The first tests to be examined are cognitive ones developed in the Learning Abilities Measurement Project (LAMP). Unlike the traditional selection and classification test currently used by the USAF, this new battery of tests is based on an information processing approach to learning. Here, more basic factors related to learning such as speed of processing and working and long-term memory capacity are measured rather than the more traditional measures of aptitude such as verbal and quantitative abilities.

The second purpose of APT is to expand the criterion space beyond that currently used for validation. At present, the measure used to validate USAF selection and classification tests is technical school final grade. Although this is a good measure, it captures only a part of a person's knowledge about the job. New criteria will be developed using training outcome measures currently gathered in technical school. Broader criteria will allow a more accurate estimation of the validity of the tests.

Concurrent with the primary work, APT scientists will be involved in research on computer testing issues. Among the issues to be addressed are the contribution of previous computer experience to computer test performance. Investigation of such issues will enhance the validity and the fairness of the tests.

The APT program will benefit the USAF by identifying tests which provide greater selection validity and more classification efficacy than do the tests currently used.

OPR: AL/HRM, (210) 536-3713 [DSN 240]

Recruit being evaluated with computerized test battery.

Simulation Utility Management System

The future outlook for the DOD is a decline in total budgeted dollars resulting in overall enlisted force reductions. To remain operationally prepared, the USAF must be concerned with optimal force structures and experience mixes within and across career fields that maintain mission readiness while minimizing overall costs of training and maintenance of the enlisted force. Conceptually, tradeoffs should be possible between experience, productivity, and force size; i.e., a more experienced force may need smaller numbers of personnel to maintain a desired level of productivity.

The Simulation Utility Management System (SUMS) model provides manpower managers and policymakers with a tool to analyze the effect of manpower decisions and personnel policy on specific enlisted career fields or overall force structures. Given an initial force structure and accession pool, SUMS simulates a policy decision (e.g., 10 percent force reduction in the third year) and evaluates the overall force productivity changes based on that decision. In addition, SUMS provides the end strength, accessions, and overages/shortages for each year of the simulated time period. SUMS can also analyze current force structures and assist in the determination of optimal force structures given a desired future end strength in terms of aptitude and experience within and across USAF specialties.

OPR: AL/HRM, (210) 536-2257 [DSN 240]

SUMS allows personnel managers to simulate the effects of force structure policy changes.

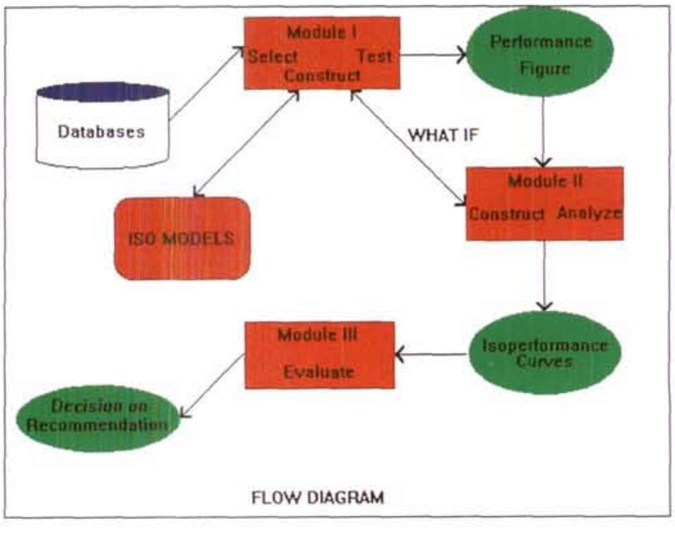
Isoperformance Methodology as a Framework for Human Systems Integration: SBIR Study

In recent years weapons systems and products have become more advanced as technology advances, and logistics requirements have increased in kind. Weapons development contractors are faced with a dilemma because the costs related to system/product acquisition and support are increasing at alarming rates, while the climate of decreasing military budgets results in less money. In view of these trends, one of the greatest challenges facing the Defense Systems Acquisition process today is to meet the need for more effective and efficient use of our resources. The national push to increase productivity in an environment of tight resources has placed emphasis on all phases of the weapon systems' life cycle. As a result, one primary requirement for weapon systems developers is to analyze the logistics, human factors, and manpower, personnel, training, and safety implications of alternative approaches as part of the weapon systems' design process in order to maximize human systems' effectiveness.

The Human Systems Center is conducting a Phase I Small Business Innovation Research (SBIR) study to assess the applicability of Isoperformance Methodology as a Framework for Human Systems Integration (HSI) issues in the design and acquisition of weapons systems. The study has several advantages: (1) it is a cost-effectiveness analysis and as such directly addresses the need not only to have HSI solutions, but also to have affordable solutions; (2) it provides authentic tradeoff functions; and (3) isoperformance is not an isolated approach but could be integrated with other HSI approaches. Phase I will result in the draft of a script that will guide the user through the design process using a question-and-answer approach with supplemental illustrative and informative materials. This will provide the basis for a computer program designed to run on USAF standard microcomputers.

The benefits anticipated from this study include integration of human factors issues and how to develop technically sound, meaningful tradeoff functions into the design process. A successful effort would do much to forward the current state of these integration methodologies. In particular, study results are expected to contribute innovative techniques to Armstrong Laboratory efforts such as the Manpower, Personnel, and Training Decision Support System.

OPR: HSC/XRS, (210) 536-2424 [DSN 240]



FLOW DIAGRAM

Cycle Ergometry Fitness Test

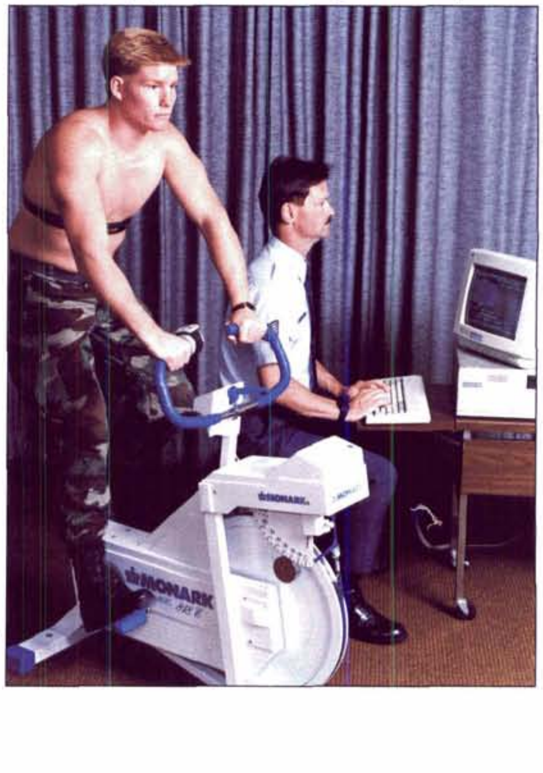
USAF interest in the cycle ergometry method for determining individual physical fitness began in the early 1980's when field studies showed that an alarming number of USAF ground crew were physically incapable of performing strenuous operational tasks under simulated chemical/biological warfare conditions. The fact that all of these "failures" had successfully completed the annual USAF fitness test (i.e., 1.5-mile run or 3-mile walk) was evidence that these methods of measuring fitness were not identifying problems of physical unpreparedness. However, the Armstrong Laboratory demonstrated that a safe and relatively simple estimate of cardiovascular fitness from heart rate response to submaximal exercise on a cycle ergometer could accurately predict performance in a variety of tasks requiring strength and stamina.

The cycle ergometer test is based on the physiological principle that heart rate increases directly with increases in work intensity. Exhaustion occurs when an individual's heart rate has reached its maximum, which is estimated as being 220 minus age. Thus, for a given level of work, the higher the heart rate, the greater the stress and the closer an individual is to his or her limit of performance.

The precision instrument used in the cycle ergometry test allows one to accurately measure exercise heart rate response to a precise workload. People with high heart rates at low workloads are significantly less fit than those with low heart rates at high workloads. Fitness scores represent cardiovascular fitness, and standards are based on (1) population averages that are age related, and (2) levels required for specific physical tasks.

The cycle ergometer program was adopted as mandatory for all USAF firefighters in March 1989. At about the same time, the program was selected for evaluation in a model health promotion program at Carswell AFB TX; it was adopted as the fitness testing method for all students entering the Air War College (Maxwell AFB AL); and it was being requested for implementation in a number of Air Force Health Promotion programs in all commands. In May 1991, this program was implemented on a trial basis at HQ Air Force Systems Command; it was subsequently adopted as the new fitness-testing program and implemented command-wide in February 1992. During this same period, General McPeak, Air Force Chief of Staff, directed the USAF Surgeon General to take responsibility for implementing this cycle ergometry fitness testing program for all USAF personnel, thus replacing the 1.5-mile run/3-mile walk test.

OPR: AL/CFTO, (210) 536-3464 [DSN 240]



New USAF Physical Fitness Test: Computer-guided cycle ergometry for assessing cardiovascular fitness.

Air Force Uniforms

The USAF is undergoing dramatic changes in composition and structure in the nineties and the uniform is changing right along with it. This is the first major design change to the entire service dress uniform since its inception in the days of General "Hap" Arnold. USAF men and women have completed testing the new uniform design. The wear test was conducted primarily in three areas of the country with approximately 800 participants. The wear test lasted from May to November 1992, and questionnaire collection and analysis were completed in January 1993.

Various changes have been introduced to the new uniform, including a more streamlined design. On the service dress coat, simulated welt and flap pockets have replaced the patch pockets. The "US" on the collar and the name tags have been eliminated. New rank designations and buttons were also tested. Two new styles of the skirt were tested for women. Both styles were designed to fit a wide range of body types while allowing more room for walking. In a move toward using more natural fabrics and commercially available components, the three fabrics tested were polyester/wool blends. The fabric selected for both officers and enlisted was the 55 percent polyester/45 percent wool serge weave.

Various designs for wear of officer's rank (such as sleeve braid) were evaluated in wear test evaluations.

The styles for both men and women are similar with a three-button front, greater ease and a more comfortable fit.

The Human Systems Center's Air Force Clothing Division also develops all other new uniform items for the USAF such as the women's maternity jumper, tuck-in blouse, slacks, and (for both men and women) a new polyester/wool shirt fabric. Furthermore, we modify existing uniform items to improve comfort, wear, and serviceability to the members of the USAF.

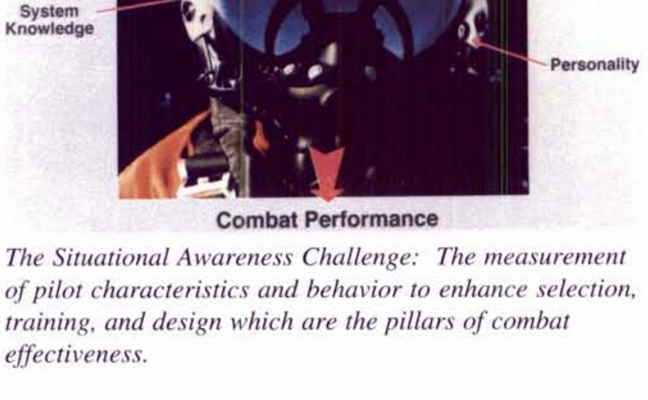
The end result is a simple yet distinctive appearance. The design changes, new fabric, and wear testing contribute in producing a USAF uniform that members can wear proudly to reflect their profession.

OPR: HSC/YAG, (513) 255-4733 [DSN 785]

Pilot Situational Awareness

According to the Air Force Times, many of the friendly fire casualties during Operation Desert Shield/Storm occurred because pilots mistakenly believed they were in free-fire zones. Studies of air combat since World War I have shown that relatively few pilots (4 to 5 percent) account for about 40 percent of the combat kills. These statistics represent both breakdowns and successes of situational awareness. USAF/XO defines situational awareness as "a pilot's continuous perception of self and aircraft in relation to the dynamic environment of flight, threats, and mission, and the capability to forecast, then execute tasks based on the perception."

Situational awareness is a unifying concept behind much of Armstrong Laboratory's human factors research. New display technologies are developed to improve the pilot's situational perception and prediction of tactical trends. New control technologies seek to improve the pilot's capability to execute necessary actions. Selection and training prepare a pilot to accomplish the mission. Armstrong Laboratory has been at the forefront for developing system assessment metrics including tools for pilot workload evaluation. Current research emphasizes developing and validating subjective, performance based, and physiological situational awareness metrics. Armstrong Laboratory researchers have evidence that near-sensory-threshold information processing is an essential and trainable situational awareness skill and are testing a low cost training device. Other Armstrong Laboratory research has identified the critical behavioral components of situational awareness in multiship air combat. This information is being used to develop training guidelines and devices.

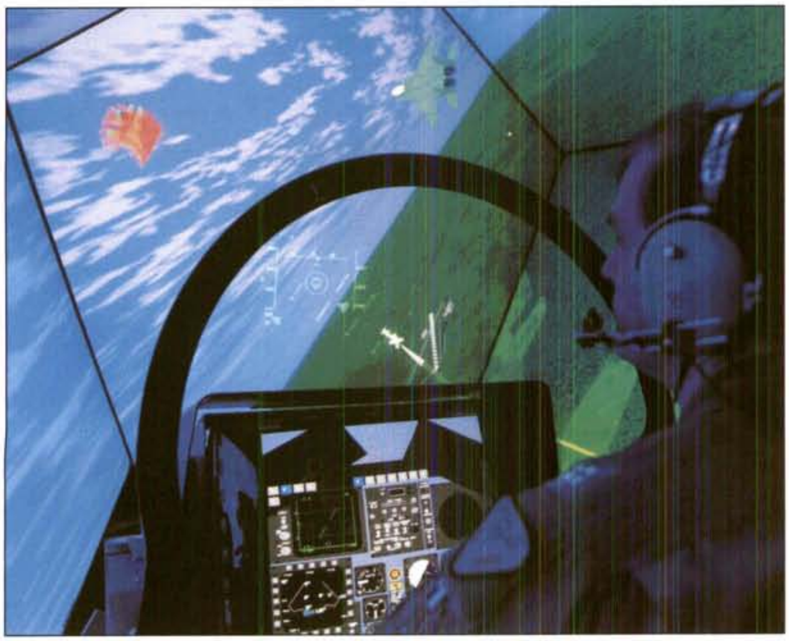


The Situational Awareness Challenge: The measurement of pilot characteristics and behavior to enhance selection, training, and design which are the pillars of combat effectiveness.

In a response to a request from the USAF Chief of Staff, Armstrong Laboratory researchers formed the Situational Awareness Integration Team known as SAINT to perform a quick response research program. The program has three main objectives: (1) develop measures of pilot situational awareness, (2) identify tools for selecting pilots most likely to develop good situational awareness, and (3) identify tools for training situational awareness. Armstrong Laboratory scientists have developed two rating scales to elicit expert judgment on pilot situational awareness performance. A computer based selection test battery has been developed to measure fundamental cognitive dimensions of situational awareness. In addition, the test battery includes some tactical game-like software that may train important situational awareness components. The program includes a validation of the scales and selection tests to be conducted in the high fidelity Multiship Training Research and Development facility at Williams AFB AZ. Air Combat Command is fully supporting this program with critical pilot resources.

OPR: AL/CFHP, (513) 255-8750
[DSN 785]

Training for Situational Awareness



Future aircrew training programs will enhance the pilot's situational awareness during combat.

While success in air combat requires a certain level of competence in both procedural and perceptual motor skills, it is the general consensus that the most important skills are cognitive in nature. Throughout air combat, pilots are continuously gathering information from the environment, making judgments about the intent of their adversary, deciding upon the best course of action from a larger set of alternatives, evaluating the success of their actions, and deciding when their chosen course of action is no longer appropriate. Such behaviors have been included under the umbrella concept of "situational awareness" or SA.

A cross directorate research program has been initiated to address issues of measurement, selection, cockpit design, and training. Of specific interest to the Armstrong Laboratory Aircrew Training Research Division is the issue of how to train for enhanced SA during tactical flight operations. Specifically, the objectives are to: (1) develop and validate measures of SA and its components for air combat operations; (2) develop and validate quantitative models of aircrew behavior during air combat; (3) conduct controlled experiments investigating components of SA in an attempt to determine the underlying situational assessment, judgment, and decision-making processes employed by tactical pilots during combat operations; and (4) develop and evaluate training methods and techniques for measurably improving SA during combat operations.

The long-term goal of this research program is to gain an understanding of the components of SA, to determine which elements are most crucial to success in air combat, and to develop training programs designed to enhance a pilot's SA during combat. Such an understanding should lead to a better characterization of differences between novices and experts and, more importantly, how these differences develop. Without a basic understanding of this skill development process, training will likely continue in its current haphazard process in which expertise simply "emerges" as a function of practice. Given the likely decrease in training resources, the preferred alternative would be to "shape" expertise. However, without an understanding of the basic decisional components of air combat, such a prospect appears unlikely.

OPR: AL/HRA, (602) 988-6561 [DSN 474]

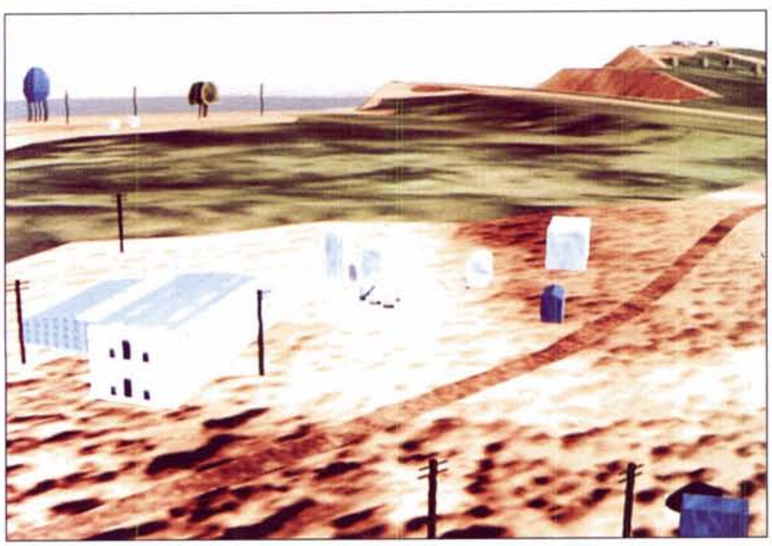
Aircrew Training Systems

USAF aircrew training programs are designed as integrated systems of academic coursework, simulator instruction, and flight training. Recent advances in training technology provide new techniques for USAF aircrew training. There is also a shift toward contracting the design, delivery, and support of aircrew training. A number of technical and management issues must be considered to maximize effectiveness and control costs. The aircrew training system research program provides principles, procedures, and user-oriented guidelines to support USAF acquisition and operational training agencies.

The initial phase of this research effort produced the Model Aircrew Training System (MATS), a major design effort that used modern learning theory to restructure how aircrew training is conducted. The C-130 Aircrew Training System (ATS) specification was based on MATS principles and implemented at Little Rock AFB AR and six other operating bases. An analysis of cost and training effectiveness data from the old and new training systems revealed a reduction in cost with the new approach, largely from reductions in flying hours and numbers of instructor personnel needed. Lessons learned during acquisition, development, and implementation of the C-130 ATS were documented. Evaluation and training information issues, requirements, and key design features are being described based on lessons learned and extensive analyses of operational USAF training programs and organizations.

Armstrong Laboratory's Aircrew Training Research Division recently initiated a research partnership with the Special Operations Forces (SOF) community to address training system effectiveness and mission rehearsal issues, taking advantage of newly acquired rehearsal capabilities collocated with the SOF formal school at Kirtland AFB NM. The goal of the rehearsal research is to develop guidelines for effective integration of emerging rehearsal technologies into the mission preparation process and to document the impacts of these technologies.

OPR: AL/HRA, (602) 988-6561 [DSN 474]



Simulator photo of special operations mission.

Multitask Trainer

The Multitask Trainer (MTT) is a research and development effort aimed at providing a squadron-based trainer. This goal led to the following requirements: a high-fidelity training environment (including cockpit fidelity, real time simulation, and networking for team training); a "pilot-friendly" low cost flexible and extensible design; modular hardware and software; a small package for a classroom or deployment, and concurrence. The physical device is a fully functional three-dimensional cockpit with all cockpit controls and incorporates F-16C aircraft simulation. The air conditioning and the computers necessary to drive the real time simulations, cockpit instruments, instructor/operator station, and a one-channel visual are self contained. The MTT can be split apart to fit through a 36-inch doorway and requires only three 110-volt, 20-amp circuits, ensuring access to any squadron classroom. It uses actual aircraft code to ensure high fidelity avionics and concurrence. Existing high fidelity Air Force owned operational flight-trainer (OFT) software provides the aircraft simulation. Government owned software was converted to keep development costs and risks low, while maintaining the highest fidelity simulation in existence. The MTT is a 5- by 6-foot box that can be produced at a fraction of the cost of an OFT. It is capable of training many mission critical tasks at the squadron level and can be deployed with the unit to continue combat mission training in the field.

A simulator using actual aircraft avionics software modules not only provides concurrence but also offers many opportunities in programs other than training. The MTT design could provide in-depth test of proposed line replaceable unit updates prior to aircraft tests. These updates could be prototyped and even put into specified squadron trainers for user feedback prior to design freeze. The same concept could be carried into new aircraft development. In this case the prototype/trainer software becomes the designed, written, and tested aircraft code.

The technical success of the program and its impact on the future of aircrew training device design led the Air Force Materiel Command to select the MTT program as the USAF "Technology Demonstrator" for the 1992 international air shows. Armstrong Laboratory's Aircrew Training Research Division (AL/HRA) is conducting the program with an in-house contractor. The first device was delivered to the 926th Fighter Group in New Orleans, LA in August 1992.

OPR: AL/HRAD, (602) 988-6561 [DSN 474]

The F-16C Multitask Trainer provides high fidelity training within a portable platform costing only a fraction of existing trainers.

Night Vision Device Training Research

The capability afforded by Night Vision Devices (NVD) for the conduct of nighttime military operations has literally revolutionized modern warfare. Certainly, the recent war in the Persian Gulf was a convincing demonstration of an overwhelming military advantage due in large part to night vision technology. NVDs, primarily night vision goggles (NVG) and forward-looking infrared (FLIR) sensors, have become an integral part of night operations for many aircraft, both rotary and fixed-wing. While NVDs impart a significantly increased capability over unaided night vision, their restricted field of view and reduced resolution (visual acuity) are somewhat deficient when compared to unaided day vision. In addition, the imagery produced by NVDs has unique characteristics that require specific interpretive techniques which must be learned by the operator. These aspects of night vision technology have a significant impact on operational procedures and training requirements.

Night Vision Device Training in the "Test Lane"

It is a certainty that nighttime military operations will receive even more emphasis in the future, but training at night will be constrained by shrinking resources, airspace restrictions, and reduced manning. Cost-effective ground based training systems and facilities will be essential.

(Continued on page 72)

(Continued from page 71)

To effectively employ NVDs, aircrew members must understand the physiological and operational limitations of the devices. The requirement for USAF-wide NVG aircrew training program was identified in an AFISC Functional Management Inspection of Night Vision Goggles (PN 89-622) and by the USAF NVD Working Group which includes representation from all major commands using NVDs. The Armstrong Laboratory Aircrew Training Research Division, Night Vision Program Office, was established to meet the operational training requirements of both existing and future systems.

After thorough review of existing DOD NVD aircrew training programs, research objectives were developed with user inputs and contributions by subject-matter experts. The first completed product was the NVG Test Lane, which combines a specially designed NVG resolution chart (developed at AL/CFHV) and standardized light source with a comprehensive set of adjustment and assessment procedures. The NVG Test Lane provides, for the first time, a practical means by which NVGs can be adequately adjusted and functionally assessed in an operational setting. This capability is vital not only for initial NVG training, but also for routine preflight procedures in operational units.

A prototype course for NVD ground training has also been developed and is now in use or undergoing implementation by all USAF major commands. Individual modules include (a) Visual Physiology and Spatial Orientation, (b) Fatigue and Circadian Rhythm, (c) The Night Environment and NVD Theory, (d) NVG Adjustment and Preflight Assessment Procedures, (e) Cockpit Procedures and Lighting, (f) Lessons Learned, and (g) Hazards and Emergency Procedures.

Efforts in video media development include the production of individual video tapes that address NVG adjustment procedures and a broad spectrum of NVG effects, limitations, and illusions, and an interactive videodisc to be assessed as a self-paced stand-alone audiovisual instructional aid. Work is also underway on the integration of NVG video into existing interactive computer based training software. Future work will include similar products for FLIR and other electro-optical devices as they become operational.

Basic visual research is underway to enhance our understanding of aided night vision. This includes the investigation of size and distance perception with NVGs and the role of unaided peripheral vision on aircrew performance during NVG-aided flight. NVD visual display effectiveness, training transfer effectiveness, and simulator sickness studies are planned.

Activities in advanced simulation technology involve the development of specialized databases and image generators for NVD simulation and helmet-mounted visual displays designed to provide a low cost, deployable, ground based aircrew training capability.

The objective of the NVD Training Research Program is to produce cost-effective, comprehensive ground based training that prepares aircrew members for the unique aspects of NVD employment and enhances USAF operational capabilities and safety in night operations.

OPR: AL/HRA, (602) 988-6561 [DSN 474]

Multiship Training Research and Development

Realistic training for tactical air-to-ground and air-to-air battle is difficult, dangerous, and costly. Combat mission training for the air combat forces has limitations such as use of tactical ranges, frequency of practice, and capability to rehearse specific missions. Advances in simulation technology are needed for combat training such as affordable training devices, networking for interactive force-on-force training, and rapid turnaround databases for mission rehearsal. The Multiship Training Research and Development (MULTIRAD) project will develop, integrate, and evaluate several simulation and training technologies for this purpose. The focus is on acquisition and maintenance of multiship air-to-air and air-to-ground aircrew combat readiness. The goal is to identify specific training needs for a joint air/land battle exercise and match those training needs to cost-effective training devices.

During 1990, in cooperation with Defense Advanced Research Projects Agency (DARPA), simulator network (SIMNET) version 6.6 was installed, including expansions to include USAF weapon systems. Both local area and long-haul networking of aircrew training devices were demonstrated. Training effectiveness research and development was initiated with ACC to identify combat tasks that could be effectively trained using ground based simulators. During 1991, a variety of training devices were integrated to the SIMNET network. Extensive testing of this expanded protocol was initiated in cooperation with DARPA, Naval Training Systems Center, Institute for Simulation and Training, and industry. Training utility evaluations are underway to identify the training potential of low cost aircrew training devices. During 1992, MULTIRAD directly supported DARPA's efforts in WAR BREAKER. This simulation recreates the last months of SCUD hunting during Operation Desert Shield/Storm.

The MULTIRAD program will provide the simulation and training effectiveness tools needed to enhance critical multiship aircrew skills. This capability will be used to develop and evaluate multiship air-to-air and air-to-ground training systems. Ultimately, results of this R&D will provide the air combat forces with the capability to more realistically train for a joint service air/land battle exercise.

OPR: AL/HRA, (602) 988-6561 [DSN 474]

Realistic Multiship Training.

Intelligent Training Technology

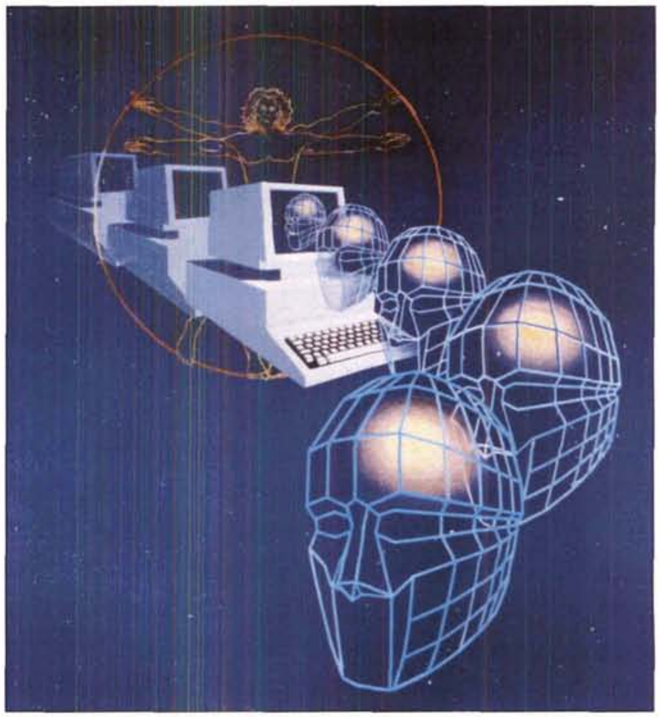
While USAF weapon systems demand increasing levels of technical expertise, the availability of quality trainees is diminishing. Advancements in artificial intelligence enable computerized instruction that adjusts to the knowledge and ability of each trainee. These advancements will enable faster, more effective training of personnel from diverse educational backgrounds and minimize errors in complex maintenance and operations tasks. The Intelligent Tutoring System (ITS) integrates subject-matter expertise, instructional methods, and student modeling to produce human-like tutoring environments. Products of this research include intelligent tutoring systems, intelligent authoring systems, and instructional effectiveness assessment technology. Users of this research include Air Education and Training Command, Air Mobility Command, Space Command, the USAF Academy and NASA.

Completed ITS products include tools for rapid development of expert knowledge bases and tutoring systems. Ongoing efforts oversee the development of tutors for various purposes. For example, the Intelligent Computer-Assisted Training Testbed (ICATT) will support development of intelligent simulation based training systems for equipment maintenance tasks.

An ICATT prototype was completed in 1992. Another example, the Fundamental Skills Research Program addresses the critical thinking skills required for basic literacy in the United States. Test sites for this project were established at eight public schools nationwide during 1992. In addition, subject-matter-specific tutors have been developed for weather forecasting, satellite console operations, auxiliary power unit maintenance, and cryptographic equipment maintenance. Other ongoing research topics address natural language processing, intelligent hypermedia knowledge bases, machine learning, and authoring system capability for microcomputers.

The payoff is faster, more cost-effective training of USAF personnel. ITS will provide greater consistency between technical training schools and on-the-job training, reduced cost and development time for computer based training, and critical technology for the private sector.

OPR: AL/HRT, (210) 536-2034 [DSN 240]

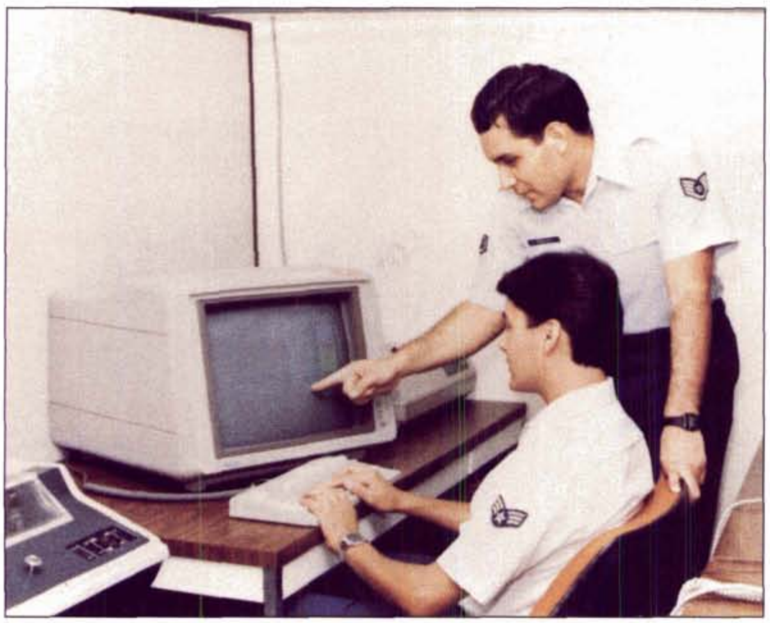


Intelligent training technology will result in faster, more cost-effective training for USAF personnel.

Advanced Instructional Design Advisor

The USAF must provide personnel with technical training for a number of weapon systems and missions. At the same time, we are experiencing a significant cutback in resources to support training requirements and a decrease in the number of instructors. In turn, there will be increased demand for computer based instruction (CBI). The Advanced Instructional Design Advisor (AIDA) project will provide automated and intelligent tools to assist novice instructional designers in the development of effective CBI. AIDA incorporates two technologies from artificial intelligence: case-based reasoning and expert systems. One AIDA component provides detailed guidance for designing CBI for several cases which are fully elaborated and available on line. A second component uses expert system technology to collect and configure reusable lesson frameworks appropriate for a variety of specific instructional purposes.

An evaluation of these technologies in USAF technical training settings has been conducted. Initial results indicate such techniques and tools can be used by subject-matter experts with little background in CBI and development time can be reduced by a factor of ten. An experimental AIDA has been prototyped and is now undergoing formative evaluation. The initial effort will target electronics and aircraft maintenance training. It will provide four on-line cases and four intelligent lesson frameworks. These frameworks will be integrated with a front-end advisor which will query users for information about students, course objectives, and content. It will then provide an initial configuration appropriate to that specific instructional development effort.



The Advanced Instructional Design Advisor project will provide automated and intelligent tools to assist novice instructional designers.

AIDA will enable subject-matter experts to develop effective CBI without extensive training. Use of this technology will significantly improve the productivity of CBI developers and enable the USAF to produce effective CBI without recourse to expensive contract efforts. Additional payoffs include: (1) reduced training time, (2) decreased TDY costs, (3) development and delivery of CBI closer to the workplace, and (4) instruction that can be delivered using distance learning technologies.

OPR: AL/HRT, (210) 536-2981
[DSN 240]

Maintenance Skills Tutor

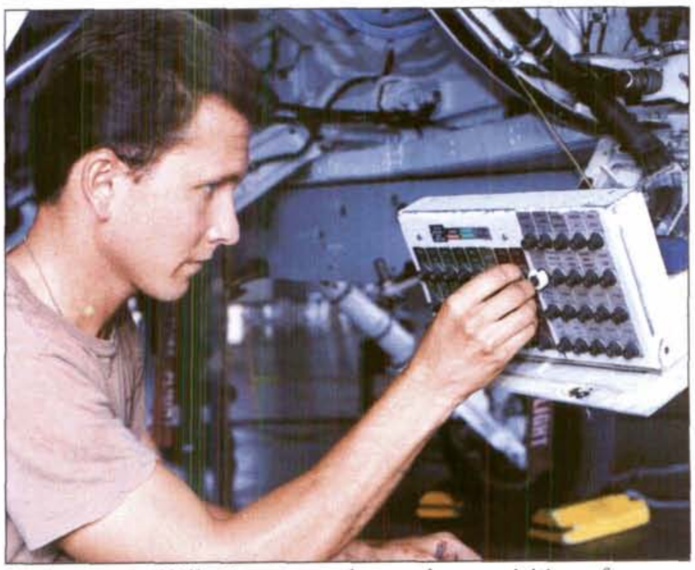
Well trained, productive maintenance technicians are essential to USAF readiness. Today, the thinking skills required for maintaining complex weapon systems and support equipment cannot be adequately taught in existing formal schools and on-the-job (OJT) training programs. In the past, weapon systems and support equipment failed frequently, providing many opportunities for learning through field experience. This is no longer the case because today's weapon systems breakdown less often. In addition, we are reducing the number of technicians per aircraft through the RIVET WORKFORCE program. As a result, each technician must have broader based knowledge and skills. Air Combat Command (ACC) identified a need to improve flight line maintenance technician troubleshooting skills normally taught through time consuming and manpower intensive OJT.

In response to the Air Combat Command need, Human Systems Center's Basic Job Skills (BJS) research program is developing two complementary technologies. First, cognitive analysis techniques were developed to examine novice versus expert troubleshooting strategies and to develop effective training techniques. These techniques are documented in the Cognitive Task Analysis Procedural Guide. Second, artificial intelligence based tutors are being developed to present trainees with a computerized interactive troubleshooting environment for problem solving. They also provide coaching hints and feedback. Prototype tutors were demonstrated at ACC fighter wings at Langley AFB VA and Eglin AFB FL. Novice technicians showed significant gains in proficiency after only 20 hours of training.

The Human Systems Program Office is developing operational Maintenance Skills Tutors (MST) for ACC based on the Basic Job Skills technology. ACC identified this technology as a top priority for fielding. MSTs for tactical aircraft maintenance specialists, flight line avionics, and other USAF specialties are being developed.

The MST effort has several payoffs: (1) faster more complex skill learning, (2) increased adaptiveness and efficiency of technical personnel, (3) reduced need for retraining, (4) increased productivity and ability to carry out the mission. This technology can be transitioned to private sector settings for effective training of complex problem-solving tasks.

MST OPR: HSC/YAR, (210) 536-2477
BJS OPR: AL/HRT, (210) 536-3570
[DSN 240]



Maintenance Skills Tutors accelerate the acquisition of complex skills.

Advanced Training Systems

Even with today's high technological capabilities, training systems remain both labor and paperwork intensive. The effectiveness of training systems can be maximized by carefully blending operational requirements with instructional strategies, student flow, media selection, instructor skill level, lead time, and available resources. The Advanced Training System (ATS) is an interactive computer support system being developed to automate the training processes at Air Education Training Command's (AETC) Technical Training Centers (TTC). When fielded, it will perform and unify training management, development, delivery, testing, and evaluation. The USAF plans to utilize this new capability to control the training services of the TTCs.

The ATS system will perform all functions involved in training including registration, scheduling of courses and students, monitoring student flow through the system, and recording of student evaluations. In addition, ATS will assist the instructor in course development and presentation; ultimately, it will control training from beginning to end. This distributed system of personal computers interfaces with larger computers strategically located to facilitate data storage and network transfer. ATS will interface with the Air Force Training Management System at Randolph AFB TX and other TTCs using existing military telephone and data networks.

The system is designed for maximum portability and hardware independence. Transition to ATS began in 1993 at Keesler AFB MS TTC. This program provides AETC with an integrated, computerized network system which capitalizes on modern interactive media and provides efficient transfer of instructional information throughout the training environment. With the full implementation of this program, training costs will decrease as training effectiveness improves. The ATS can be transitioned to automate any military or civilian schoolhouse environment.

OPR: HSC/YAR, (210) 536-2477 [DSN 240]

Advanced Training Systems will unify training development, delivery, testing, and evaluation.

Base Training System

Several years of hard work and perseverance by the Human Systems Center (HSC) has paid off in the development of a prototype USAF enlisted on-the-job training system known as the Advanced On-the-Job Training System (AOTS). In 1988-89, the Human Resources Laboratory demonstrated the feasibility of this advanced training technology in the operational environments of Tactical Air Command (TAC), Air Force Reserve (AFRES), and Air National Guard (ANG). The system integrated the three main components of training (management, evaluation, and training development/delivery) into one complete training system. The work involved was primarily software development because hardware was to be purchased off the shelf; thus, no hardware was developed. In July 1990 the implementation of the management portion of the AOTS was given the go-ahead with further enhancements to follow in the coming years.

Shortly thereafter, the AOTS program was transitioned to the Human Systems Program Office as the Base Training System (BTS). BTS is an HSC "high-gear" program approach to meet the immediate needs of the user. HQ USAF/DPP (AF On-The Job-Training Policy) serves as the requirements manager. BTS standardizes all aspects of the OJT management processes and allows supervisors and training managers across the active duty, civilian, ANG, and AFRES communities to perform their OJT jobs more quickly and efficiently. The management system (their first priority) software from AOTS was modified to work on the USAF standard AT&T 3B2 minicomputer. The 12th Flying Training Wing at Randolph AFB is conducting an operational assessment of the prototype system. The program is awaiting approval of the Air Force Training and Education Automated Management System requirements board and will upgrade the software prior to USAF implementation.

BTS uses existing base level communications and computer infrastructure to allow for maximum access. It automates training records for officers, enlisted, and civilians to allow real time training requirements and training status to be determined. The BTS has automated interfaces with the Personnel Data Systems to obtain military and civilian personnel data to allow each USAF supervisor to have a current and complete training template for every USAF member. This approach optimizes the reuse of existing data while injecting state-of-the-art OJT management where it is most needed. This fosters greater productivity and enhances the quality of "total person" USAF training.

BTS continues to pursue this state-of-the-art training system in support of today's and tomorrow's user needs. This system can be applied to any military or civilian training management need.

OPR: HSC/YAR, (210) 536-2477 [DSN 240]

Training Impact Decision Systems

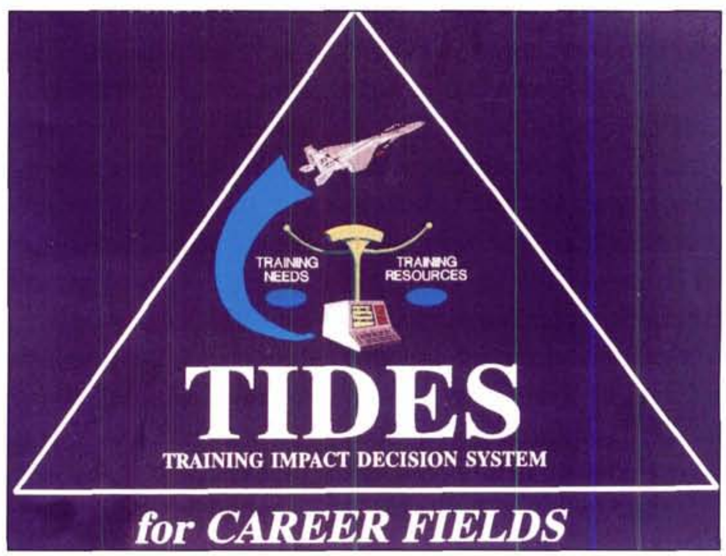
USAF planners and training managers face a complex array of variables when making broad decisions on career field training. Changes in the Manpower, Personnel and Training (MPT) system can have unanticipated long-term impacts. Budget fluctuations, job restructuring, and policy revisions involving training and the force structure add further complexity. The Training Impact Decision System, or TIDES, helps key decision makers recognize the impact of these factors on the training system. TIDES integrates information about jobs, personnel utilization factors, training costs, resource requirements, capacities, and managers' preferences in identifying the optimal allocation of training resources.

TIDES identifies which tasks within a specialty to train, the career points at which training should be provided, and the optimal combination of training settings--formal classroom instruction, self-paced study, hands-on training, or on-the-job training (OJT). Analysts use TIDES to dynamically model the current utilization and training pattern of a specialty and then assess alternative scenarios based on proposed changes to the specialty. For example, TIDES assesses the impact on personnel, resources, cost, and mission resulting from a decision to add or eliminate a training course, front load OJT into technical training courses, or recruit industry trained personnel. Decision makers can use TIDES information to manage career fields, optimize resources, and develop Career Field Training Plans (CFTP). Users of this research include HQ USAF, HQ Air Education and Training Command, and operational major commands.

In 1988, proof-of-concept work was completed on this technology. Exploratory development of the forerunner to TIDES, the Training Decisions System (TDS), included development of training cost and capacity models, the analysis methodology, and supporting data files for eight Air Force Specialties (AFS). Advanced TIDES research is aimed at designing a template for CFTPs and developing a user interface that facilitates data manipulation and analysis.

The payoff to the USAF is a systematic method to enable functional and training managers to maximize efficiency and training effectiveness while minimizing training costs, yet still provide the means to produce the highest quality fully trained forces.

OPR: AL/HRT, (210) 536-2932 [DSN 240]



Training Effectiveness and Efficiency Model

With today's fewer resources and increased complexity of jobs, the USAF will find the Training Effectiveness and Efficiency Model (TEEM) an invaluable asset. The TEEM method will enable the USAF to make knowledgeable decisions in the realm of training. TEEM not only identifies deficient or excessive training, but also helps determine the content validity of that training.

TEEM examines training efficiency with a comparison between field recommendations of task training emphasis and the actual emphasis given in the classroom. Under- and over-trained tasks are quickly identified and revised making the training program revision process both more time and cost efficient.

TEEM methodology addresses the effectiveness of training by examining the job performance and knowledge level of the identified over-and under-trained tasks. These results could then be used to facilitate training course changes. For example, training time might be reduced for overtrained tasks that were performed well, while training time might be increased for undertrained tasks where performance was low.

TEEM, written in IBM compatible software, is applicable to all enlisted and officer specialties for all USAF and military contexts including Active, Reserve, and Guard components. In addition to its military application, TEEM is suitable for civilian training assessment. To date, TEEM has been utilized for the aerospace ground equipment mechanic and aerospace physiology instructor training program analyses. TEEM will provide the USAF with a reliable and accurate feedback device for refining technical training to better meet the field requirements.

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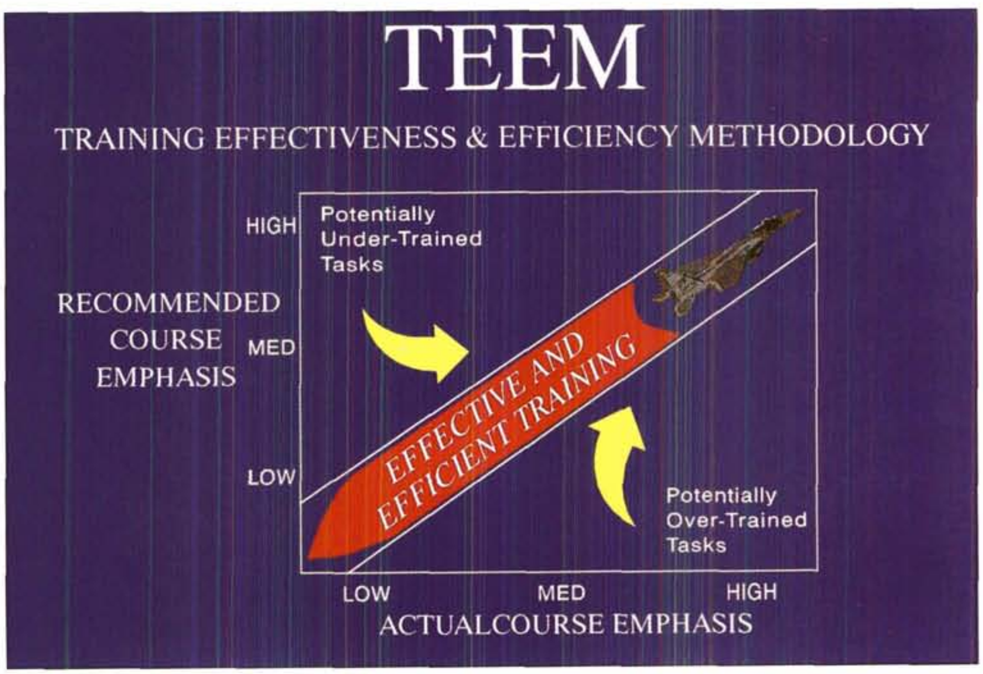


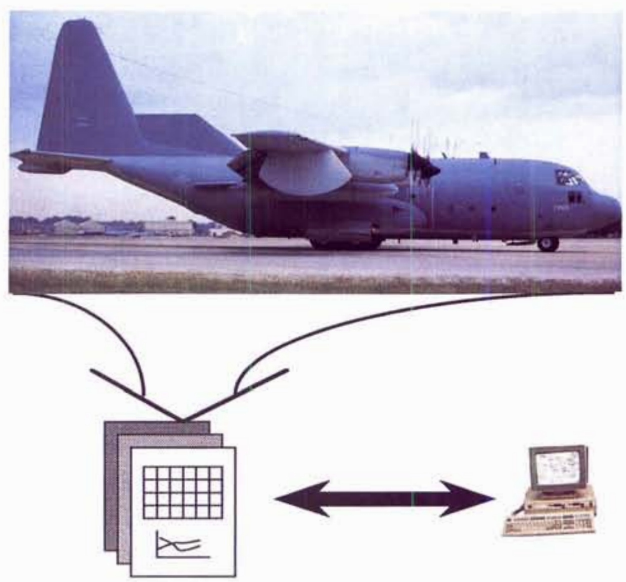
Maintenance Skills Training Studies

USAF maintenance organizations are adapting to new challenges resulting from several significant personnel, technological, and organizational trends as well as budget realities. A growing need to enhance troubleshooting skills, capture lost expertise, and transfer years of maintenance technical experience has generated strong interest in Human Systems Center Intelligent System Technology. Accordingly, major commands need to assess the applicability of tutors to improve maintenance skills and substantiate requirements documents for program funding.

An analysis of an Air Combat Command (ACC) F-16 and F-15 maintenance skills needs and technology assessment was completed to support transition of Armstrong Laboratory technology to the Systems Program Office for the planning of a full-scale development effort. Since the effort dealt with development of an unprecedented system with respect to acquisition, evaluation of software development approach, and programming language issues an initial risk had to be assessed. The study substantiated that use of Intelligent Tutoring Technology was necessary to address ACC needs. In addition, technology assessment and associated supportability issues laid the groundwork for determining applicability of this training technology to USAF-wide maintenance technician training requirements such as for the Air Force Special Operations Command (AFSOC).

As a natural outgrowth of the original maintenance skills study for ACC, a needs analysis and capability assessment was initiated in FY92 for the AFSOC. The study will provide a basis for AFSOC training program planning. The mission of AFSOC and the different types of aircraft imposed a diversity of maintenance skills required which entailed a study broader in scope than the corresponding study for ACC. The applicability of Human Systems Center training technologies--intelligent tutors, in particular--is being assessed to address AFSOC maintenance-training problems. This will also result in determining the applicability of tutors to other MAJCOM needs and thus foster the improvement of proficiency and efficiency of USAF maintainers.

OPR: HSC/XRS, (210) 536-2424 [DSN 240]



Analysis captures technology application for maintenance training on the flight line.

Integrated Maintenance Information System

IMIS uses computer technology to replace hard copy technical orders and aids in diagnosing maintenance

USAF maintenance personnel are called upon to repair increasingly complex modern weapon systems. Maintenance must be accomplished under a wide variety of deployment scenarios and with fewer maintenance specialties. Technicians must have ready access to huge amounts of technical information to maintain aircraft. The Integrated Maintenance Information System (IMIS) is an automated system which is being developed to provide the technician all of the information that is needed to do the job from a single source.

The IMIS consists of a small Portable Maintenance Aid (PMA) computer, maintenance information workstations, and an aircraft interface panel. The PMA provides technicians with rapid access to all the information required to find and fix maintenance problems. This includes step-by-step instructions, troubleshooting guidance, part numbers, illustrations, and aircraft maintenance history. The PMA directly connects to the aircraft to run built-in tests and extract aircraft system data for use in troubleshooting.

User requirements studies have been conducted to ensure that the system meets the technicians' needs. It is being developed in a phased approach, with field tests being conducted to evaluate each new capability as it is incorporated in the system. In the most recent test, the diagnostic capabilities were tested using the F/A-18 as the test bed. Technicians used maintenance instructions, diagnostic guidance, and the PMA/aircraft interface to identify faults in the aircraft. The test demonstrated that technicians can troubleshoot more effectively when using the IMIS. A full-scale IMIS is presently in development which will demonstrate and test all IMIS capabilities.

IMIS technology will save millions of dollars by reducing maintenance time and by reducing the inventory of spare parts. It will improve deployment capability. Electronic media will replace the vast bulk of paper technical orders. Also, the IMIS will enhance the country's technology base and maximize the return from our investment in weapon systems.

OPR: AL/HRGO, (513) 255-2606 [DSN 785]

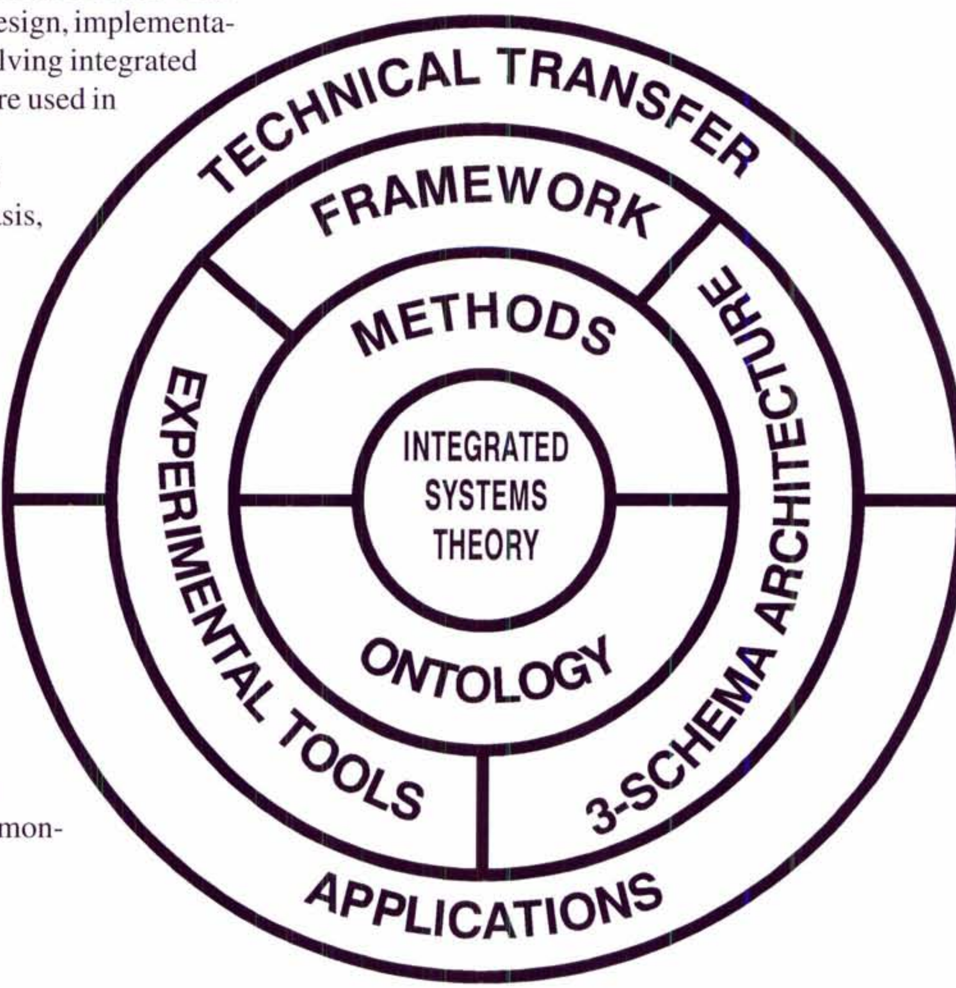
Information Integration for Concurrent Engineering

Modern technology is cursed with inefficiencies in information management; for example, software packages that are unable to input data from other software packages, special-purpose methods and procedures, nonstandard data repositories, etc. The overall effect of this diversity keeps organizations from integrating their information. The Information Integration for Concurrent Engineering (IICE) project is developing the critical technologies for information integration in support of concurrent engineering processes. These technologies will provide a structured engineering approach to life cycle activities associated with the definition, engineering, design, implementation, and maintenance of evolving integrated information systems which are used in concurrent engineering.

In order to set the IICE project on a firm scientific basis, the program is designed to have theoretical as well as experimental and application components. This has led to a wide range of user interest: invited participation in prestigious conferences, requests for information from numerous DOD agencies, even funds contributed by the Army Natick Research and Development Center to initiate a concurrent engineering pilot project at their facility. A demonstration is currently being planned at a USAF air logistics center.

The IICE technologies have the potential to save the government millions of dollars by creating the capability for integrated concurrent engineering enterprises. Products include, methods for integrated design, frameworks which guide the choice of design tools, flexible information storage, and a design environment which supports the concept of evolving enterprises.

OPR: AL/HRGA, (513) 255-7775 [DSN 785]



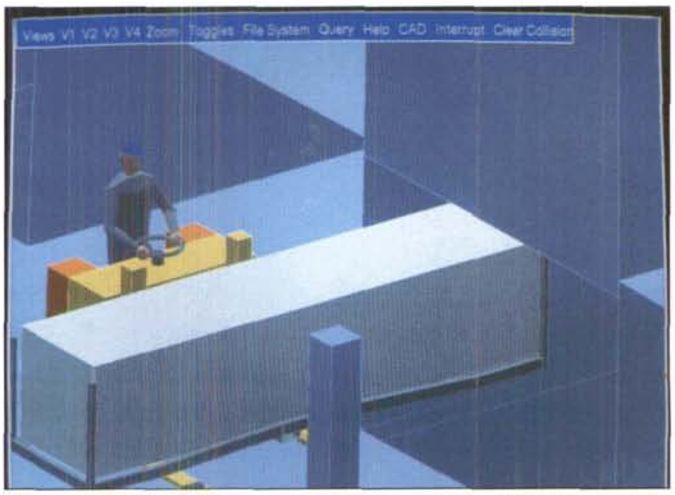
Design Evaluation for Personnel, Training, and Human Factors

Human resources constitute a large share of the cost of USAF system maintenance. If we can account for these costs when systems are being designed, we will acquire more efficient systems. This is the goal of the Design Evaluation for Personnel, Training, and Human Factors (DEPTH) program. DEPTH uses dynamic human figure modeling to present realistic images of people interacting with equipment and the workplace on a computer aided design (CAD) screen. Modern CAD graphics can accurately simulate critical elements of proposed maintenance and repair procedures. We will no longer rely on costly and time-consuming physical prototypes to perform human task analysis. Instead, DEPTH creates a "virtual prototype" for task analysis that allows human/machine interactions to be visualized and manipulated.

The DEPTH task analysis workstation draws on two human modeling technologies. The Armstrong Laboratory's "Crew Chief" provides accurate body sizing, strength and related data on USAF maintainers. The University of Pennsylvania's "Jack" model provides an interactive system for human figure animation and control. We are combining these two technologies into a flexible, powerful, inexpensive CAD graphics workstation for task analysis. New technologies implemented through DEPTH will include virtual reality devices which allow realistic simulation of the work environment and multimedia/hypertext software for "activation" of human performance data. These technologies will simulate a wider range of human abilities and task conditions than current human models. Human performance through DEPTH task simulation will join other engineering disciplines as a full partner in Integrated Product Development. By including human modeling results with Logistics Support Analysis data systems, we will unify the many elements of Human Systems Integration (HSI) involved in system support. Human factors; workplace safety; maintenance manuals; and manpower, personnel, and training domains all rely on DEPTH task documentation. In this way, the Computer aided Acquisition and Logistics Support, or CALS ideas of digital creation, management, and reuse of design data will be served.

DEPTH technologies are being demonstrated at General Electric Engines in Cincinnati OH and Oklahoma City Air Logistics Center. As new capabilities are added, the range of DEPTH applications will include manufacturing job design and space logistics problems.

OPR: AL/HRGA, (513) 255-6797 [DSN 785]



Computer aided design graphics simulate maintenance and repair procedures.

Aerospace Medicine

This Human Systems Center product area provides research and specialized operational support in aeromedical consultation, epidemiology, drug testing, and hyperbaric medicine, as well as development, fielding, and support of aeromedical systems and equipment.

Civil Reserve Air Fleet Aeromedical Evacuation Shipsets

Installation of these shipsets in existing commercial B-767s will enhance our wartime capability to evacuate the injured.

Immediate transport of critically wounded patients from battle zones to medical facilities is crucial for effective treatment. Military airlift capability is augmented by the Civil Reserve Air Fleet (CRAF), composed of civilian aircraft contracted for military service. These aircraft must be converted to enable evacuation of severely injured patients. The CRAF Aeromedical Evacuation Shipsets (AESS) were developed for Air Mobility Command to permit rapid reconfiguration of civilian B-767s during wartime.

CRAF AESS consists of litter stanchions, nurses' workstations, therapeutic oxygen storage/distribution equipment, and electrical power/distribution equipment designed for installation without prior or permanent modification to the aircraft. This enables the B-767 to transport up to 111 litter patients, 40 ambulatory patients, and 10 medical personnel. Shipsets can be installed and removed 20 times (each), stored for 30 years, and can fly for 5,000 flight hours. Full operational capability for the scheduled buy of 34 B-767 shipsets occurred in 1994.

Prior to the end of the Persian Gulf Conflict, 10 B-767 shipsets were produced in an accelerated program to support Operation Desert Shield/Storm. In a departure from the baseline program's concept, which anticipated that reconfigured aircraft would fly to and from civilian airports, the Desert Storm aircraft were flown from East Coast USAF bases to military installations in Germany and England. The shipsets would have allowed 10 aeromedical B-767s to free up, by best estimates, 17 C-141s to exclusively carry war materials, greatly contributing to both care of the wounded and resupply of the war effort.

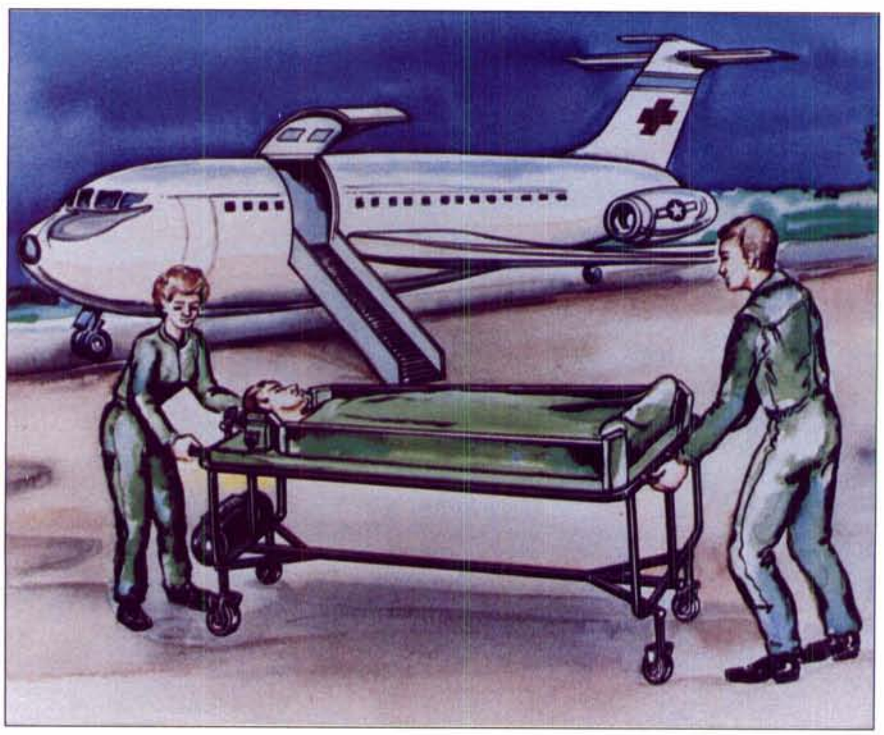
OPR: HSC/YAM, (210) 536-2664 [DSN 240]

Spinal Cord Injury Transportation System

Safe transportation of spinal cord injury patients between medical treatment facilities is necessary to prevent further trauma to the patient. The objective of this program is to ensure that patients with spinal cord injuries who must be airlifted significant distances receive the same quality of care in transit that would be available from medical treatment facilities. The Spinal Cord Injury Transportation System (SCITS) will incorporate the latest in kinetic therapy including continuous side-to-side motion for treating and preventing complications of immobility, skeletal traction, and stability for the spine.

There are several operational performance parameters that are unique to the SCITS design and its aeromedical evacuation mission. SCITS must be sufficiently light and portable so that four individuals can pick up both it, and the patient, for transport into the medical evacuation aircraft, ambulance, or ambus. Furthermore, this device must fit properly into the standard litter stanchion used onboard those evacuation vehicles. Since medical evacuation aircraft impose additional requirements above and beyond those of an ambulance or ambus, the SCITS must be made of lightweight materials (with a total weight of less than 200 pounds) and must be extremely durable to withstand the rigors of flight. Medical evacuation aircraft on which SCITS will be used include the C-9, C-17, C-27, C-130, C-141, and the Civil Reserve Air Fleet (Boeing 767).

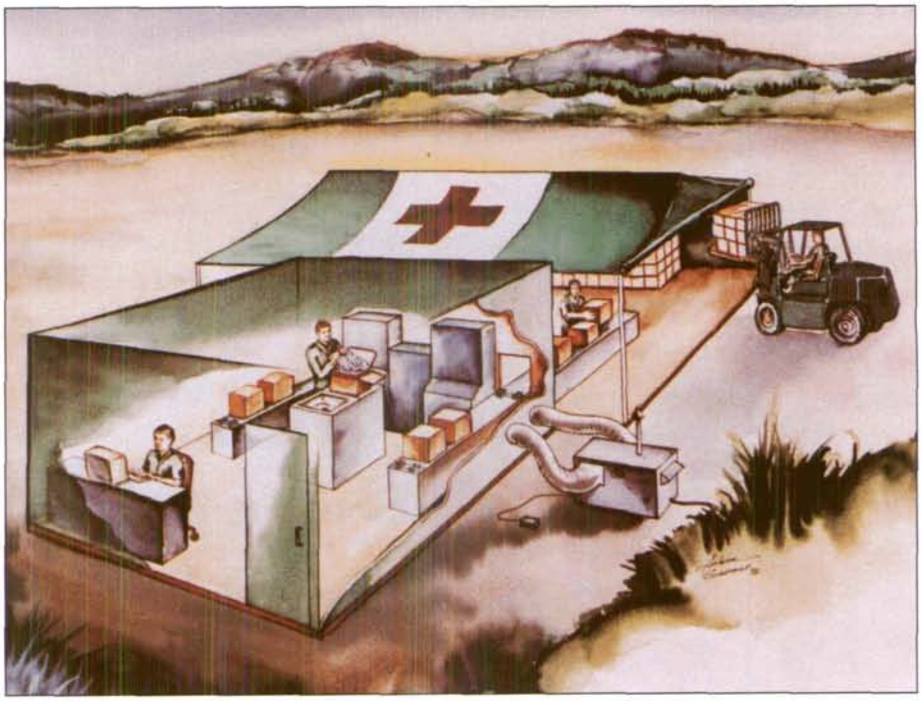
Planned award of the research and development contract is in FY94. Once an acceptable prototype is developed, a production effort will build approximately 180 units. These devices will be fielded in FY97 and will replace the Stryker Frame that is currently used by Air Mobility Command, the USAF Reserve, and the Air National Guard.



OPR: HSC/YAM,
(210) 536-2664
[DSN 240]

Patients with injuries to their spinal cords can be safely airlifted over long distances.

Transportable Blood Transshipment Center System



TBTC enables shipment of large quantities of liquid and blood.

An urgent need exists for a liquid/frozen blood system to meet future military blood needs. The DOD Military Blood Program Office is responsible for ensuring an adequate blood supply, and the USAF is the lead service for the airlift of blood products. Current blood transshipment facilities are vulnerable, not mobile, and cannot handle large quantities of frozen blood products.

The Transportable Blood Transshipment Center (TBTC) system will enable shipment of large quantities of liquid and frozen blood products. Each TBTC includes refrigerators, freezers, ice makers, and shelters to store over 7,500 units of blood. The TBTC provides the capability to communicate and coordinate blood requirements, and it ensures environmental protection of blood products, equipment, and system operators. The TBTC can be transported anywhere in the world and can be operational in 48 hours. An integral part of the TBTC design is the Frozen Blood Shipping Container (FBSC) which will provide thermal protection for up to 48 hours. The FBSC contains a reusable coolant, thus avoiding the problems of shipping blood with dry ice. A prototype TBTC will be developed with a likely follow-on production of seven additional units. The TBTC Request for Proposal was released to industry in late 1990 with contract award in March 1991. Initial operational capability is scheduled for 1995.

The TBTC will allow frozen blood to be pre-positioned in theater. This will decrease the time required to get blood products to the wounded in time of war and decrease the initial demand on our strategic airlift forces.

OPR: HSC/YAM, (210) 536-2664 [DSN 240]

Chemically/Biologically Hardened Air Transportable Hospital

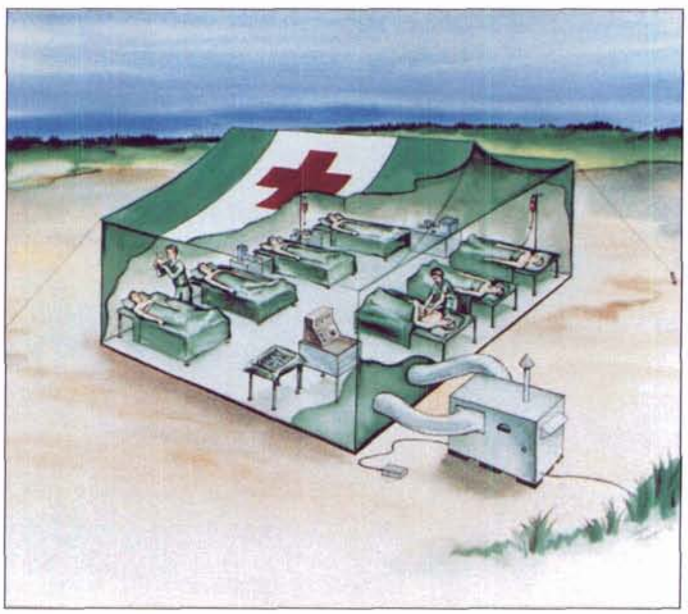
Immediate treatment of injured and wounded personnel is critical to survival and recovery in both combat zones and on humanitarian relief missions. The recent experience of Operation Desert Shield/Storm identified several shortcomings in the current standard of care while employing present Air Transportable Hospitals (ATH). The USAF started the Chemically/Biologically Hardened Air Transportable Hospital (CHATH) to improve the current field medical capabilities of the US Air Force and US Army.

The CHATH program will make four major improvements to field medical care. First, a chemical and biological protection from enemy weapons will be provided for the first time to the medical complex. Second, a constant temperature control will be provided for field patients in all weather environments encountered around the globe. Third, a clean fixed-site hospital environment will be available in the field for the first time. This will prevent the spread of infection and speed stabilization and recovery of patients. Fourth, the field hospitals will be able to admit and treat casualties during active enemy attack instead of waiting until the attack is over. This will greatly speed critical medical care access to the injured. These improvements can be made within the current medical care system.

The CHATH program will modify the current (ATHs) and retain the same medical equipment and personnel. The CHATH program will utilize existing and modified Army equipment to line the current ATH tents and provide an airtight shelter. The Human Systems Program Office is developing a new Chemically/Biologically Hardened Air Management Plant (CHAMP). The CHAMP units will provide chemically/biologically filtered fresh outside air, recirculate and filter interior air to a clean hospital standard, provide heating and cooling, and provide its own backup power for use in blackouts or when electricity is not available.

The CHAMP prototype development efforts began Spring 1993 with full unit testing in Spring 1994. Complete qualification testing will take place in 1995. Two complete hospitals will be assembled and field tested by Air Combat Command in the Summer of 1995. Production of all 27 new CHATHs is scheduled to begin in 1996.

OPR: HSC/YAM, (210) 536-5114 [DSN 240]



An important modification to existing "hospitals" will protect occupants from both chemical and biological attacks.

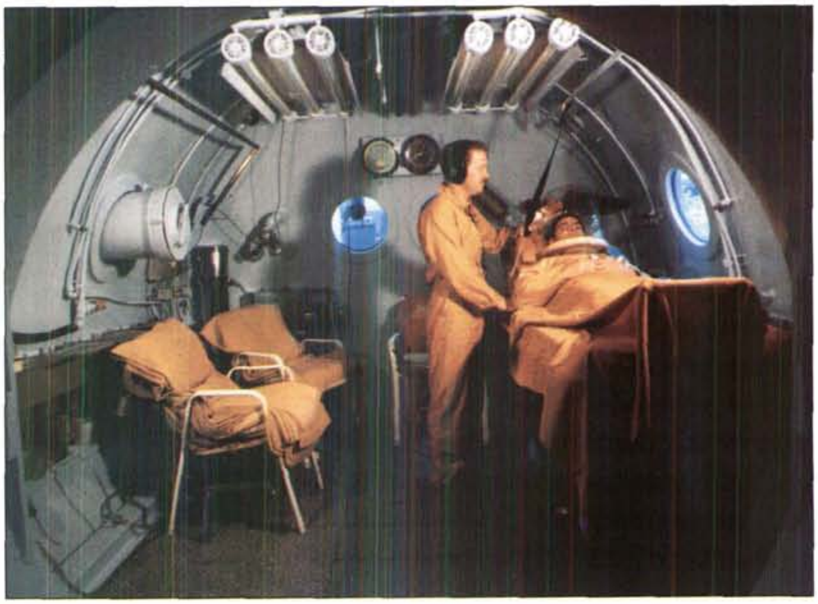
Hyperbaric Medicine

The role of the Armstrong Laboratory Davis Hyperbaric Laboratory (DHL) has expanded tremendously since 1974 when its primary purpose was to treat aviators suffering from decompression sickness. The DHL, is today internationally recognized as a leading center in patient treatment, facility requirements, safety standards, and research using Hyperbaric Oxygen (HBO). HBO is used to treat indicated medical disorders such as chronic nonhealing wounds, carbon monoxide poisoning, osteoradio-necrosis, gas gangrene, and air gas embolism. The DHL presently serves as the lead agency for all DOD Clinical Hyperbaric Facilities and establishes policy for all USAF Clinical Operational (Field) Hyperbaric Facilities. DHL personnel continually work to broaden the understanding, application, and acceptance of HBO therapy through both clinical and basic scientific research. Team members spearhead medical research efforts in the areas of nonhealing wounds, oxygen toxicity, recompression therapy, burns, and crush injury.

To date, our personnel have treated over 3,500 patients. Staff physicians provide worldwide consultation activities around the clock. As the DOD lead agency, the DHL coordinates facility expansion and personnel training including clinical hyperbaric fellowship for US Air Force, US Army, and international physicians, physiologists, and nurses along with enlisted medical and physiology technicians. They have established contacts with private and governmental research organizations in facilities research and assisted NASA in developing specifications for hyperbaric treatment capabilities aboard Space Station Freedom. The DHL leads the way in hyperbaric chamber design and fabrication. Efforts are underway for improved design and construction of facilities including the first concrete hyperbaric chamber. Evaluation of alternate construction strategies may result in greatly reduced construction cost and increased transportability.

The primary payoff is improved overall healing time for many debilitating conditions. This directly translates into reduced hospitalization time and associated medical costs for the DOD. For example, HBO reduces the healthcare cost for treating burn patients by as much as 30 percent. More importantly, the quality of life is immeasurably improved for patients who otherwise face amputation of limbs or continuation of longstanding conditions resolved by hyperbaric oxygen therapy.

OPR: AL/AO, (210) 536-2941 [DSN 240]



Patients in an oxygen rich environment.

Dental Investigations

USAF medical readiness requires that equipment be appropriate and effective. The USAF Dental Investigation Service (DIS), located at Brooks AFB TX provides a central point for rapid identification and resolution of equipment, material, and facility issues relative to dentistry. The scope includes technical evaluation of commercial equipment and materials for DOD dental use worldwide. DIS conducts a variety of standardized equipment and material evaluations in-house. In addition, clinicians of USAF clinics worldwide perform users' evaluations under DIS direction. DIS provides consultation service for dental construction projects and dental infection control standards for the USAF.

During 1991, DIS performed 54 project investigations, $1.6 million in Equipment Action Requests, and responded to over 4,200 telephone requests for technical information and support from headquarters and operational levels. DIS completed compilation of all patient treatment delivered outside the continental US in conjunction with Operation Desert Shield/Storm (16,000-plus patient visits), and provided an after-action report on material problems encountered by USAF dental personnel deployed during the Persian Gulf crisis. Over 90 facility design actions were accomplished on construction projects valued at over $400 million. DIS publications are sent to over 750 separate federal dental facilities.

DIS maintains close relationships with universities, hospitals, and other interservice agencies and cooperates with national agencies such as the American Dental Association, Federal Drug Administration, and Centers for Disease Control to establish standards for dentistry. DIS has formal agreements with the dental school at the University of Texas Health Science Center in San Antonio and the Naval Dental Research Institute at Great Lakes Naval Air Station.

OPR: AL/AOCD, (210) 536-3503
[DSN 240]

Dental laboratory personnel evaluate equipment for possible USAF use.

Central Military Reference Laboratory

The downsizing of the services has not diminished the requirement to provide cost-effective health care to service members. Advances in technology continue to increase clinician reliance upon diagnostic support services which must now be met within the constraints of tight budgets and limited manpower resources. Under a Congressional Management Efficiencies initiative, the concept of a central military reference laboratory was tested and implemented in order to meet the requirements of USAF medical treatment facilities (MTF) for supplementary diagnostic testing services. This was accomplished through expansion of Armstrong Laboratory capabilities at Brooks AFB TX.

In 1990, after a pilot project with 30 MTF test sites validated the concept while saving $2.3 million during the first year of operation, the reference services were upgraded for an additional 60 clients in 1991-92. Reference laboratory services now provided to 90 USAF and DOD MTFs incorporate a commercial overnight air courier service for specimen transport with a comprehensive laboratory information system. Printers at each local facility produce chartable patient reports within hours of test completion. Among the new clients added were a number of overseas facilities which represented unique requirements for sample transport and data transmission. Unlike many civilian laboratories offering reference services within a region, the new capabilities of the Armstrong Laboratory make it unique among reference laboratories in providing diagnostic services to international clients on a routine basis.

The success of the project is evidenced by the growth in demand for services which increased 30 percent last year. The Armstrong Laboratory reference facility processed over 450,000 computer accessions equating to 1.4 million laboratory tests. A cost/benefit model developed for tracking the project indicates a commercial market value of $8.7 million for the testing performed at a net savings to the USAF of $4.1 million. Client surveys conducted during the year reflect an overwhelming customer satisfaction and are further used to identify new or changing field requirements for diagnostic reference services. New initiatives are underway to further improve services by the addition of remote terminals at client sites and the application of barcode technology for sample accessing and tracking.

Technician analyzes samples to provide support to USAF installations worldwide.

OPR: AL/AO, (210) 536-8378 [DSN 240]

Ophthalmologic Publications

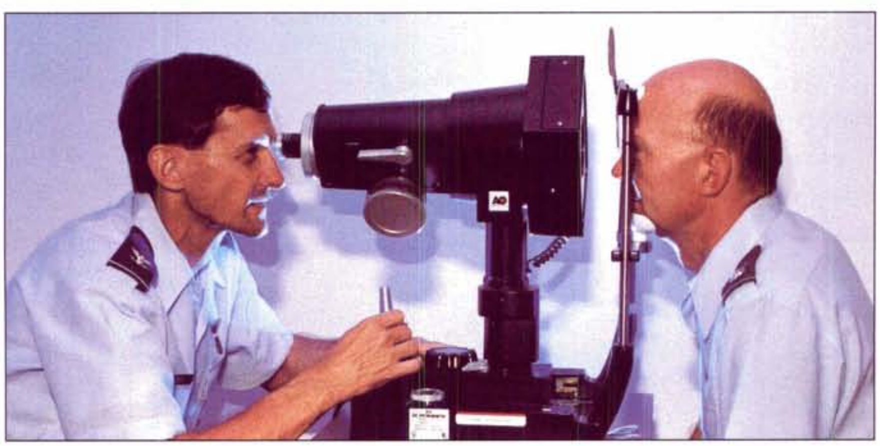
The Ophthalmology Branch of Armstrong Laboratory's Aerospace Medicine Directorate completed long-term research on three Aerospace Medicine Division (HQ AFMOA/SGPA) and Clinical Ophthalmology Branch (AL/AOCO) study groups in 1992. Each study-group research project helped aid HQ USAF personnel in understanding the visual performance limitations of fliers with ocular diseases and conditions and will enable HQ AFMOA/SGPA to set future visual standards for fliers with these diseases and conditions.

The first study group consisted of those fliers with keratoconus, a noninflammatory, usually bilateral corneal dystrophy in which the cornea progressively thins and protrudes causing high, irregular, myopic astigmatism. This leads to visual problems such as blurred vision, diplopia, glare, ocular irritation, photophobia, etc. From 1965 to 1988, AL/AOCO has evaluated 37 flying candidates and fliers with keratoconus. Of these, seven were grounded due to their disease. The other 30 managed to remain on flying status and to fly for hundreds of hours.

From 1979 to 1992, AL/AOCO evaluated 35 flyers who had cataracts removed and a plastic lens placed in one or both eyes. Prior to the use of intraocular lenses, fliers were either grounded or had to wear contact lenses. Intraocular lenses are a significant visual improvement over contact lenses. All of our fliers achieved 20/20 vision in each eye; 81 percent even achieved 20/15. Serious complications were low. All were deemed visually qualified to return to flying status at some point, and some successfully flew hundreds of hours. This surgical technique appears to be an extremely useful method of visual rehabilitation of fliers.

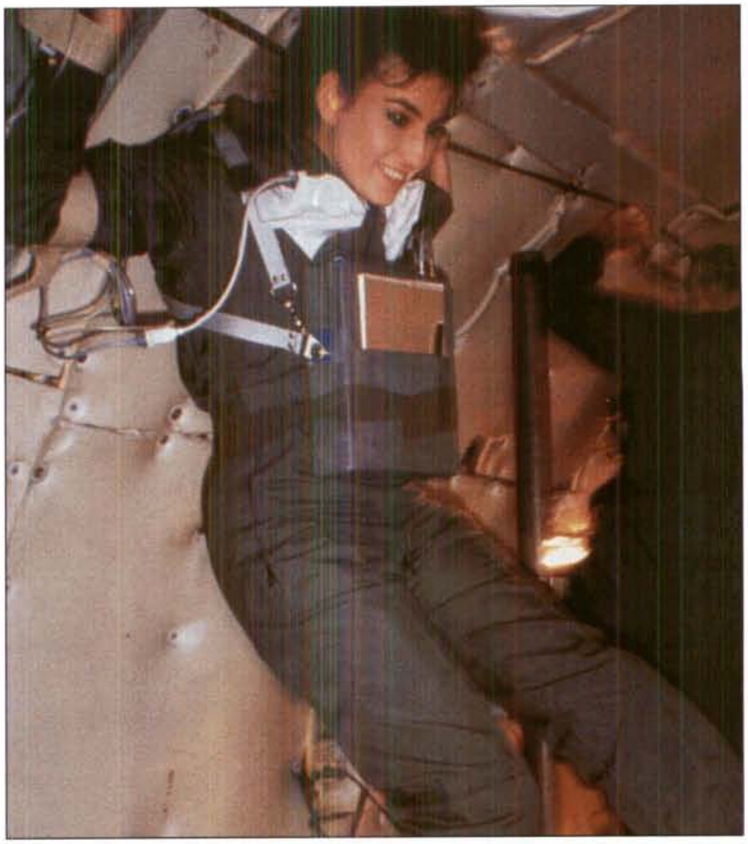
From 1977 to 1988, AL/AOCO evaluated 50 fliers who had ocular Pigmentary Dispersion Syndrome (PDS). We found, through our research, that those fliers with PDS but without elevated intraocular pressure (IOP) rarely progress. However, of those with PDS and elevated IOP, 50 percent developed glaucoma. Thus, additional screening of flying candidates merely for the pigment dispersion is unnecessary. Those with pigment dispersion and elevated IOP should be identified by tonometry. Of the fully trained fliers (with or without elevated IOP), many flew hundreds of hours with proper follow-up and treatment.

OPR: AL/AOCO, (210) 536-3250 [DSN 240]



Armstrong Laboratory physician evaluates intraocular lenses in an Air Force flier.

Laboratory for Aerospace Cardiovascular Research



Subject undergoes parabolic flight testing to study effects of weightlessness on the heart.

Sixty percent of all grounding is cardiovascular related. This represents a significant loss to DOD in terms of experienced aircrew and training expenditures. The Laboratory for Aerospace Cardiovascular Research (LACR) is a joint US Army/US Air Force effort sponsored by the Armstrong Laboratory to gain further understanding into the basic physiologic and pathophysiologic cardiovascular effects induced by the aerospace and aeronautical environments. The aeromedical community will use LACR research results to help further define physical standards for selection and retention of aircrew and address cardiovascular issues as they relate to occupational medicine concerns.

Recently, the LACR professional staff have published papers and given numerous presentations at national and international scientific meetings on the results of KC-135 testing. Testing centered on central circulatory hemodynamics and our ability to predict responses during altered gravitational states. New findings were presented concerning calculations for total peripheral resistance and ventricular vascular coupling. Transesophageal echocardiography and Evans blue dye were utilized during the parabolic KC-135 flights to investigate fluid shifts during initial entry to microgravity. This was done to simulate conditions and results discovered during space shuttle flights. Many of the successes seen in this program are the result of our recent biosensor technology developments, including advancements in chronic animal instrumentation and Doppler flow techniques.

OPR: AL/AOC, (210) 536-3202 [DSN 240]

Aircrew Aeromedical Standards

Medical standards for aircrew are dynamic, changing in response to operational environments, advanced diagnostic tools, and research. As the USAF center for operational aeromedical science and technology, Human Systems Center validates existing standards and recommends new standards to select and retain crewmembers. Each year approximately 700 grounded crewmembers are evaluated for medical qualification, with over 75 percent returning to duty. The immediate payoffs are retention of experienced personnel and avoidance of the new training costs. The long-term payoff is the refinement of aeromedical standards.

In 1992, the Supraventricular Tachycardia (SVT) study group was reviewed. Four hundred and thirty crewmembers with a mean followup of 11.4 years were studied. SVT is a cardiac rhythm disturbance of the upper chambers of the heart. The effects of the arrhythmia may range from no effects to incapacitation, but the great majority of crewmembers tolerate SVT quite well. Long-term follow-up studies have identified the approximately 10 percent of our population with SVT which would be unacceptable for return to flying. These observations will be used by the USAF Surgeon General for liberalization of waiver criteria for SVT.

The Aeromedical Consultation Center, at Brooks AFB TX is committed to support USAF readiness aggressively and economically with due concern for flying safety and the aircrew health. The aircrew standards programs returns fully qualified aircrew members to duty and provides recommended medical standards for flight qualification.

OPR: AL/AO, (210) 536-3836 [DSN 240]

Evaluation board meets to set new medical standards for USAF fliers.

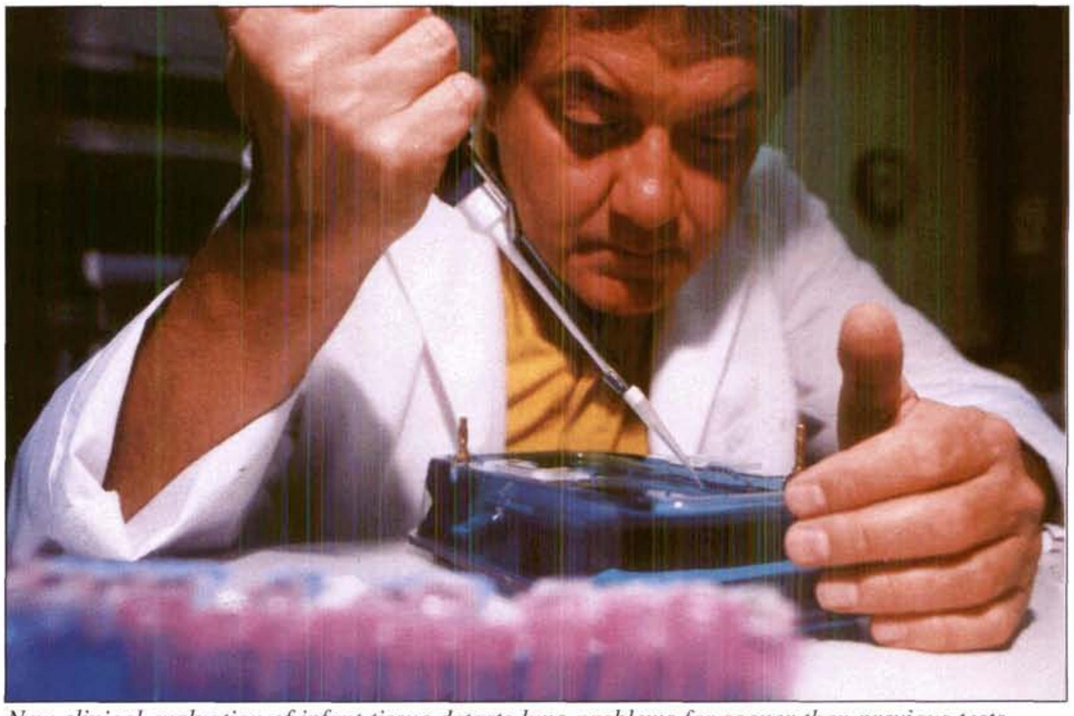
Multi-Probing System for Rapid Identification of Mycoplasma

Mycoplasmas are the smallest free-living organisms. These microorganisms cause life-threatening lung disease in premature infants. Diagnosis and treatment are often delayed because these organisms grow slowly and cannot be identified with the usual medical laboratory techniques.

A system has been developed to specifically probe and identify the Deoxyribonucleic Acid (DNA) of these organisms in clinical specimens. Clinical evaluation has shown 100 percent agreement between this DNA probe and traditional methods performed on specimens from newborns to two years. One patent is pending, and a technical paper has been published. Additional DNA probes are in development. These should be of great clinical value.

Research in the application of these techniques to rapidly identify organisms that cause toxic intestinal infections is ongoing. These infections have frequently caused problems during military deployments and combat operations.

OPR: AL/AO, (210) 536-8382 [DSN 240]



New clinical evaluation of infant tissue detects lung problems far sooner than previous tests.

Project Gargle: Influenza Disease Surveillance

Project Gargle is an integral part of the World Health Organization (WHO) collaborating centers for influenza, via the Centers for Disease Control (CDC), in the United States. In the WHO program, the Armstrong Laboratory Epidemiology Services Branch provides the CDC with a weekly summary of upper respiratory infection/influenza morbidity rates and the number of viral isolates. Data are provided by 14 sentinel USAF bases (six in the continental US and eight overseas) and are unique within DOD. Depending on the time of year and base location, the "target number" of weekly specimens submitted ranges from four to eight. Specimens are screened for seven types of respiratory viruses: influenza A and B, Respiratory Syncytial (RSV), adenoviruses, and parainfluenza (1, 2, and 3).

In every war, respiratory illness has denigrated readiness to a greater extent than combat related injury and death. The annual results of Project Gargle are used by the National Civilian Advisory Committee on Immunization Practices in reaching decisions concerning influenza vaccine formulation. The USAF's influenza immunization program serves as the key preventive medicine program for reducing the impact of influenza in the active-duty population. The success of the USAF Project Gargle program requires close cooperation between the medical staff, laboratory technicians, and military public health team to ensure that appropriate and adequate specimens are submitted. This is a very successful preventive medicine program with worldwide impact.

OPR: AL/AOES, (210) 536-3471 [DSN 240]

Testing for the newest strains of influenza keeps USAF members healthy.

HIV Screening Process

Technician performs HIV screening.

In 1985, DOD directed the screening of all military personnel for human immunodeficiency virus (HIV) and evaluation of the medical status of those infected. In response, the Armstrong Laboratory's Epidemiologic Research Division began a two-year screening of USAF personnel in August 1986 to estimate the prevalence of HIV infection. A second two-year screening of USAF personnel began in October 1988 to estimate the incidence of new HIV infections.

The first screening of USAF personnel ended in September 1988 with a prevalence of 0.95 infections per thousand individuals. The second screening of USAF personnel ended in September 1990 with an estimated incidence rate of 0.21 per thousand; lowest in DOD. The low incidence supported a five-year test interval, coinciding with the periodic physical, to monitor for changes in the incidence of HIV infection. Increasing the testing interval to five years resulted in an annual test volume reduction. This volume reduction enabled the Epidemiologic Research Division to handle all tests "in-house," which reduced costs 60 percent.

HIV screening assists in monitoring the readiness of USAF personnel in both mission performance and deployment. The ability to search a repository of HIV test results supports battlefield blood transfusion and blood bank lookback programs. Testing by the Epidemiologic Research Division has resulted in fewer administrative requirements for submitting units, decreased turnaround times for results, and closer integration of submission procedures into those of normal clinical testing.

OPR: AL/AO, (210) 536-8934 [DSN 240]

Drug Testing

As one of the eight DOD drug abuse detection laboratories, the Armstrong Laboratory's Drug Testing Division is the sole USAF laboratory implementing the DOD drug testing program. Their mission is to deter the use and abuse of controlled and illegal substances by military personnel through a comprehensive drug testing program. Supporting the DOD objective to provide a drug-free, mission ready force and workplace, the Drug Testing Division is a key player in the field commander's ability to maintain a healthy operational ready force. Over 800,000 member and quality control tests were performed in the past year.

The Drug Testing Division began testing United States Air Forces Europe in June 1992 and is currently transitioning drug testing support for Pacific Air Force personnel.

To support all USAF components worldwide, personnel in the Drug Testing Division incorporate strict chain-of-custody and quality control procedures with advanced laboratory technology. The Division analyzes more than a quarter million member specimens each year for evidence of drug abuse to include marijuana, LSD, cocaine, amphetamines, barbiturates, opiates, PCP, and others.

Serving as a reference laboratory for the National Institute on Drug Abuse Certification Program, the Drug Testing Division helps set the standard for other laboratories to follow.

Armstrong Laboratory's drug testing results are among the most accurate in the world.

OPR: AL/AOT, (210) 536-3723
[DSN 240]

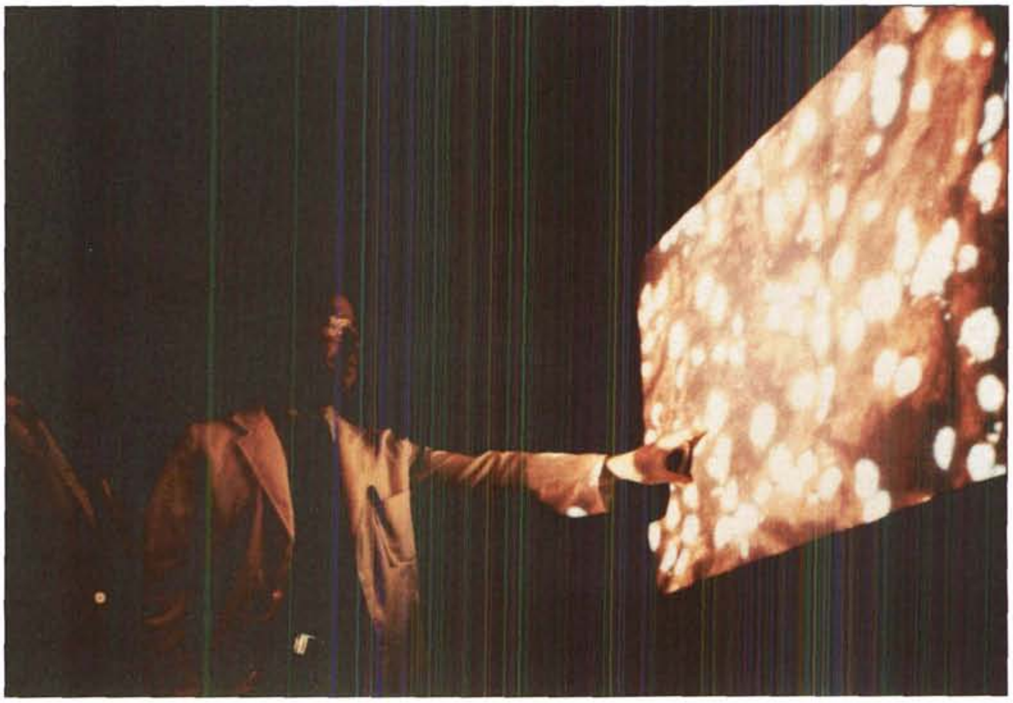
Preventive Medicine Consultation

The Armstrong Laboratory's Epidemiologic Research Division consultants manage infectious chronic and environmental disease surveillance programs. They analyze USAF, DOD, state, national, and international morbidity and mortality data and provide consultation to medical treatment facilities, major commands and the Headquarters Air Force Medical Operating Agency at Bolling AFB DC.

An epidemiologist, a public health officer, and two physicians serve as consultants. They provide hundreds of consultations quarterly. This support ranges from developing immunization recommendations and disease control strategies to providing guidance for Aerospace Medicine resident projects to assist development and fielding of fitness and other line-mandated programs. The continuous flow of consult requests is processed by a weekly rotation of the consultants whose primary responsibility is to coordinate this support.

Consultants also serve as investigators in numerous research programs and represent the USAF at national and international symposia. For example, at the 1991 Advisory Group for Aerospace Research and Development Conference held in Rome, Italy, USAF research findings on hepatitis, vaccine preventable diseases, and the human immunodeficiency virus were presented. Ongoing research efforts include analysis of USAF alcohol related morbidity and mortality and a descriptive study of the USAF hepatitis experience from 1980-1989.

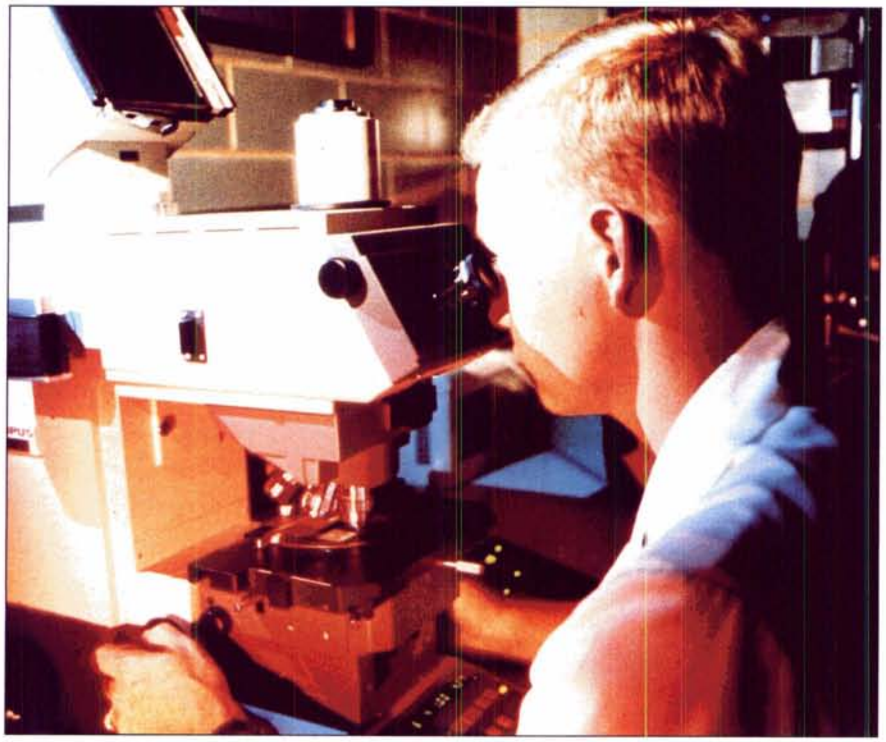
OPR: AL/AOES, (210) 536-3471 [DSN 240]



Physicians provide specialized consultation on a regular basis.

Outbreak Investigations

The investigation of disease outbreak is an important part of the mission of the Armstrong Laboratoy's (AL) Epidemiology Services Branch. Outbreaks can involve communicable diseases, injuries, occupationally related illnesses, foodborne illness, and even cancer. Surveillance systems initially note the occurrence of an apparently increased trend in a disease or syndrome, perhaps a cluster of illnesses related temporarily by location or exposure history. The AL Epidemiology Services Branch responds to USAF or DOD requests for assistance in investigating the apparent disease outbreak.



Quick response to rare outbreaks reduces the possibility of an epidemic.

An actual outbreak investigation involves collecting and analyzing data on the cases of illness or injury. Similarities (age, race, sex, or squadron) between cases can provide evidence of epidemiologic links and elucidate the circumstances of occurrence or spread. Once these associations are defined, control measures can be implemented to stop an outbreak and prevent a recurrence.

Recent examples of outbreaks include 900 cases of foodborne illness at the USAF Academy, a cluster of turberculosis (TB) skin test conversions from an active case of TB at a European base, a foodborne illness during Operation Desert Shield/ Storm, a cluster of possible occupationally related respiratory diseases in a joint allied/ USAF work site, and streptococcal disease among USAF basic recruits. The ability of the AL Epidemiology Services Branch to provide rapid professional assistance in investigating and controlling outbreaks makes it an effective preventive medicine tool and contributes to the maintenance of a mission capable force.

OPR: AL/AOES, (210) 536-3471 [DSN 240]

Ranch Hand II


Ranch Hand II investigation continues to probe the effects of dioxin used in Vietnam.

At the direction of the White House, the USAF is conducting a 20-year epidemiologic investigation of possible adverse health effects of USAF personnel involved with aerial spraying of herbicides in Vietnam from 1962 to 1971 (Operation Ranch Hand). This investigation is to determine whether long-term health effects exist due to occupational exposure to herbicides and associated dioxins. In 1982, 1985, 1987, and 1992, physical examinations were given and health questionnaires administered to approximately 2,300 study participants, including 1,000 exposed persons and 1,300 in the control group. Medical histories of spouses and offspring are also tracked. Analyses of these data were published in a series of morbidity and mortality reports. A morbidity report released in 1991 using individual serum dioxin levels as a measure of exposure revealed associations between dioxin level and HDL cholesterol, diabetes, fasting glucose, and percent body fat, suggesting effects on lipid metabolism. However, any conclusion regarding cause and effect must wait for additional data analysis from physical examinations and other corroborating studies.

A major milestone in the study, the reproductive outcome report, was completed and released in the Fall of 1992. This report examined 5,489 pregnancies and 4,514 children and found no evidence to support a hypothesis of adverse effects of paternal dioxin on reproductive outcome. Another significant milestone was reached with a further refinement of dioxin half-life. This analysis indicated that the half-life varies with changes in body weight and disease. The current estimate of half-life is approximately 13 years. We are currently in our fourth cycle of examinations. We expect to examine and report on 2,300 participants.

This program has provided information necessary for executive and congressional policy decisions regarding compensation and regulation of occupational exposures. Further, procedures to investigate issues of occupational exposures and health were established. The Air Force Health Study design is becoming the worldwide statistical and epidemiologic standard for occupational disease research.

OPR: AL/AO, (210) 536-2600
HSC/YAW, (210) 536-2274
[DSN 240]

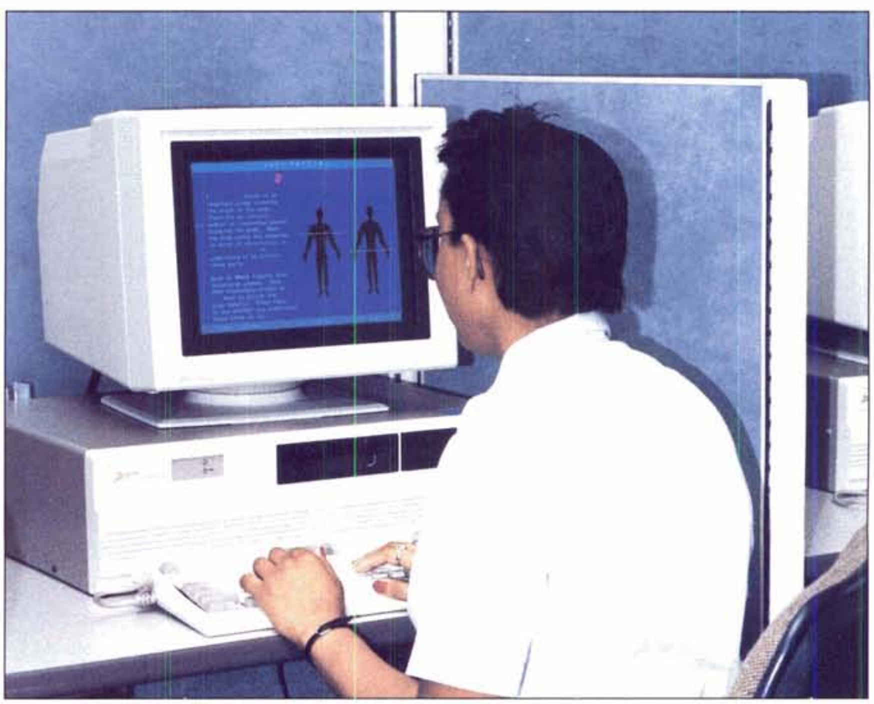
Aerospace Medicine Training Systems Analysis

The USAF School of Aerospace Medicine (USAFSAM) is currently responsible for training over 5,000 aerospace medicine professionals and technicians each year. Improvements to the present training systems are being planned in the areas of program management, engineering, and logistics support planning courseware. The USAFSAM Learning Center is upgrading hardware and authoring software capabilities on a limited scope level at this time.

The Aerospace Medicine Training Systems Analysis is being conducted to determine basic systems requirements and perform pre-acquisition planning to upgrade the present USAFSAM training systems. An assessment of the offered courses and evaluation of the training media will be conducted to ensure maximum cost effectiveness of the training methods and technologies employed.

The study will be performed as a two-phase one-year project to produce five primary products: (1) the definition of USAFSAM computer based training systems requirements; (2) a training media analysis; (3) a tradeoff analysis of existing and developing training technologies; (4) a systems specification; and (5) a long-range roadmap for future systems enhancements and direction.

OPR: HSC/XRS, (210) 536-2424 [DSN 240]



Student trains in USAFSAM Learning Center.

Operational Applications of Aerospace Medicine

The USAF School of Aerospace Medicine (USAFSAM) conducts education programs in aerospace medicine and closely related fields for officer and enlisted personnel who are in direct support of the USAF flying and missile missions. In addition to USAF members, selected students from other branches of the armed services, civilian agencies, and numerous allied countries attend courses offered at the school. Education programs are specifically designed for physicians, nurses, military public health officers, bioenvironmental engineers, aerospace physiologists, and other medical service personnel. This aeromedical education program provides quality training to over 5,000 persons each year. Courses offered range from the residency in aerospace medicine education programs for physicians to specialty training courses for airmen entering active duty. The residency is fully accredited by the Accreditation Council for Graduate Medical Education. Most of the enlisted specialty courses are accredited through affiliation with the Community College of the Air Force.

A standard course validation process fielded to the major commands (MAJCOMS) ensures the identification, documentation, and validation of the educational needs of aeromedical operations. An Education and Training Review Board validates MAJCOM training proposals which are incorporated into the training program. Courses are added, changed, or deleted based on operational need.

Computer based training is used extensively in the enlisted Air Force specialty awarding courses and is expanding in use in the professional level courses. Future plans call for the installation of a Local Area Network (LAN) which will greatly increase the students' access to large amounts of on-line information worldwide. Computer based training and the integration of high-tech educational methodologies are very much a part of the future at the USAF School of Aerospace Medicine.

A new course for flight surgeons, Aerospace Physiologists and Clinical Psychologists, was implemented in spring 1993. The Aircraft Mishap Investigation and Prevention Course is intended to prepare attendees to perform actual mishap investigations. Topics covered include aviation physiology, aviation psychology, aviation pathology, forensic pathology

Bioenvironmental engineers sampling a drum before a hazardous waste sample is obtained.

and dentistry, crash survivability, life support equipment, crash dynamics, and engineering factors in aircraft mishaps. The major emphasis of the course is on mishap investigation techniques. A new mishap lab is under construction where students will get experience in searching for evidence in a wreckage and interviewing witnesses. They will then reconstruct the accident, decide upon causes, and make recommendations to prevent further mishaps. Plans are to present the course three times per year.

The Residency in Aerospace Medicine (RAM) Program was expanded from two to three years beginning with the June 1992 class. The third year emphasizes clinical medicine topics considered key to a base level aerospace medicine program and includes rotations in occupational medicine, preventive medicine, and clinical medicine.

With the increased awareness on the importance of restoring and preserving the environment, the USAFSAM will soon expand its role in providing this vital education. Plans are underway to establish an Air Force Environmental Safety and Occupational Health (ESOH) Education and Training Integration Office within the USAFSAM. The prime role of this office will be to ensure that all USAF personnel, military or civilian, are adequately trained to carry out their ESOH responsibilities. This includes identifying disciplines and occupations requiring this education and training, the degree and level of knowledge needed, sources for the training, and monitoring the program for the entire USAF.

Through the years, USAFSAM's output of graduates and course offerings have continually expanded. Added to this is the increased complexity of the curricula. Consequently, the USAFSAM has outgrown its school facility. A new 83,500 square foot $8.9 million academic complex has been approved for construction, with completion planned for Winter 1996.

The unique blend of education, research and development, and operational aeromedical support in the aeromedical education curriculum produces qualified operationally effective aeromedical specialists for the using commands.

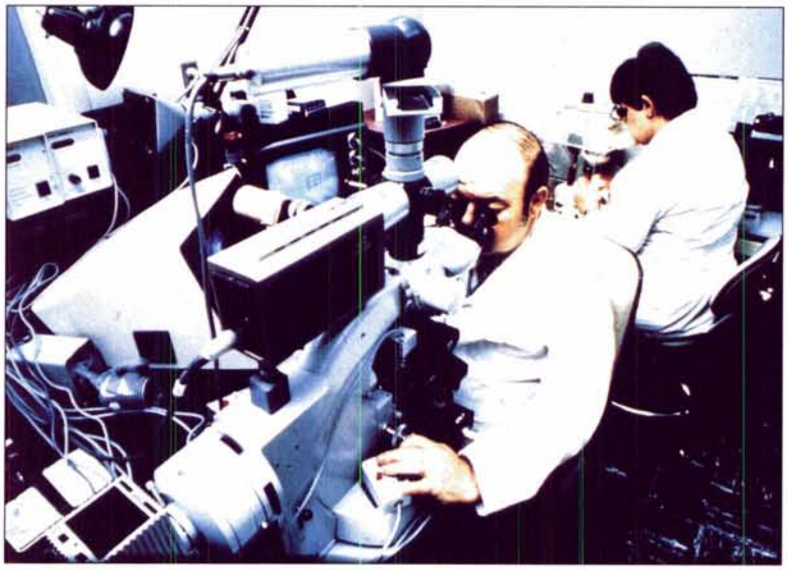
OPR: USAF School of Aerospace Medicine
(210) 536-3500 [DSN 240]

This simulation mishap acts as a training aid for a "hands-on" approach in investigative techniques.

Occupational and Environmental Health

This Human Systems Center product area assesses risks to personnel from hazardous materials, noise, electromagnetic radiation, and occupational processes in USAF operations. The work combines human-centered research and development in these emphasis areas with broad field consultation responsibilities to measure and reduce occupational illness and environmental hazards.

Asbestos Health Hazard Assessment



Asbestos fiber counting by Phase Contrast Microscopy.

It is USAF policy to remove all asbestos from the work and living areas of USAF personnel. This policy has a single purpose: prevent inhalation of unhealthy levels of airborne asbestos fibers. Base officials must follow Environmental Protection Agency (EPA) regulations for identifying and removing harmful asbestos from existing buildings. The Bioenvironmental Engineers must follow Occupational Safety and Health Administration (OSHA) requirements for monitoring occupant exposures to airborne asbestos fibers. Scientists from Armstrong Laboratory's (AL) Occupational and Environmental Health Directorate provide operational support to ensure base officials meet their requirements.

AL can analyze 6,000-8,000 asbestos samples per year. Bulk asbestos samples are analyzed by polarized light microscopy, and airborne asbestos samples are analyzed by phase contrast microscopy. Both procedures are mandated by federal law. AL also has the capability of special procedures on the scanning electron microscope. These procedures may be discussed with the laboratory. AL maintains asbestos certification with the American Industrial Hygiene Association and participates in the Proficiency Asbestos Analytical Testing Program of the National Institute of Occupational Safety and Health.

The AL provides USAF installations with information that is timely and accurate. Turnaround times are 5 to 7 days for routine samples and only hours for priority samples once received in the laboratory.

OPR: AL/OEA, (210) 536-3626 [DSN 240]

Safe Drinking Water Act Implementation

The Environmental Protection Agency's (EPA) Safe Drinking Water Act (SDWA) requires DOD to monitor, report, and notify the public of chemical contaminants in installation drinking water. It is USAF policy to provide high quality drinking water at all USAF installations. Scientists from Armstrong Laboratory (AL) provide operational support to achieve these high standards.

In 1991, AL completed a three-year effort of analysis of Phase I volatile organics as directed by the 1986 amendments to the SDWA. Scientists analyzed drinking water for 59 volatile organic contaminants from 3,600 samples from 900 USAF installations worldwide. Several bases had volatile organic chemicals in wells exceeding maximum allowable levels for which corrective action was required.

In 1992, a monitoring program of lead and copper was started for USAF installations, in compliance with the SDWA amendments. Phase II and Phase V monitoring started in January 1993. Armstrong Laboratory is preparing for rigorous quality assurance. Analysis will include volatile organics, not included in Phase I, metals, nitrate/nitrite, asbestos, pesticides/herbicides/polychlorinated bi-phenyls, and water treatment chemicals. This massive new program will cover USAF installations worldwide.

Preparing drinking water samples for metal analysis to comply with Safe Drinking Water Act requirements.

The USAF is meeting today's water monitoring requirements and is prepared for future requirements. The AL sampling analysis team will meet these challenges to ensure USAF personnel and families are provided with high quality drinking water.

OPR: AL/OEA,
(210) 536-3626
[DSN 240]

Indoor Air Quality

The Armstrong Laboratory (AL) has operated a program to investigate the causes and effects of poor Indoor Air Quality (IAQ) for the past seven years. IAQ is a term applied primarily to office space where occupants complain of health problems which disappear when they are not at work. The primary effects of poor IAQ are reduced productivity and low morale. Typical symptoms are drowsiness; inability to concentrate; dry itchy skin; irritated eyes, nose, and throat; excessive colds and allergies; and dissatisfaction with temperature or humidity.

The IAQ Program objective is to reduce illness and absenteeism among office workers and increase their productivity. AL prepares educational materials and briefings, interacts with federal agencies and national organizations, and conducts IAQ surveys at USAF bases across the continental US in an effort to prevent and remediate IAQ health problems. A key educational reference completed this year is a comprehensive "Guide for Indoor Air Quality Surveys" sent to all Bioenvironmental Engineering and Military Public Health offices. Together, with the AL Environics Directorate, we are developing guidance for base level civil engineering on the relationship of ventilation systems to IAQ. Survey customers include active duty personnel from USAF bases, the Air National Guard, the Air Force Reserve, the Defense Logistics Agency, the Army Corps of Engineers, and health professionals from the Army, Navy, Environmental Protection Agency, and Occupational, Safety and Health Administration.

In 70 percent of the over 50 buildings investigated, a major cause of poor IAQ has been inadequate design or maintenance of the heating, ventilation, and air-conditioning (HVAC) system. Other major contributors of IAQ problems are insufficient amounts of fresh air and relative humidities below 40 percent. The IAQ program emphasizes increased awareness among both civil engineering and medical specialties concerning what causes IAQ problems, our continuing support of customer requested surveys, and giving health oriented input into the HVAC design and maintenance process within DOD.

Inspecting the HVAC system for causes of indoor air quality problems.

OPR: AL/OEM, (210) 536-3214 [DSN 240]

Environmental Noise Technology Program

Noise related problems associated with air operations are increasing as the USAF requires more low-altitude/high-power flights to maintain pilot proficiency and increase aircrew survivability. Encroachment continues as communities develop near airbase installations. Base closures and force realignment exercises intensify these problems by increasing the number of aircraft (and their noise) at the remaining bases. Each change to the operations at any USAF base, range, route or Military Operating Area (MOA) requires the USAF to evaluate the environmental impacts as defined in the National Environmental Policy Act (NEPA). The USAF must accomplish comprehensive environmental noise-impact analyses to continue operations within regulatory requirements and defend itself against litigation. The Environmental Noise Technology (NOISETECH) program develops the measurement methods, metrics, databases, models, and criteria essential in defining noise exposure and assessing its effects on humans, animals, and structures.

Technological advances in aerospace systems require noise exposure assessments.

Beta testing was accomplished for the NOISETECH computer based Assessment System for Aircraft Noise (ASAN), a planning and decision support system for predicting and analyzing the effects of subsonic noise and sonic booms on humans, animals, and structures. It will be used by the USAF operational and environmental planning communities to plan operational changes and assess the predicted environmental noise impacts of these new and modified operations. When fully implemented at the major commands, ASAN will develop legally defensible documents that describe and assess the impact of subsonic and supersonic aircraft operations on wild and domestic animals. It also assesses potential damage to conventional and unconventional structures, determines likelihood of snow avalanches or landslides, and predicts individual and community annoyance responses, sleep disturbance, and potential long-term human health effects.

New modeling capability was added to the NOISEMAP computer program to evaluate terrain effects on noise propagation near the start of aircraft takeoff roll. NOISEMAP forms the cornerstone of the DOD Air Installation Compatible Use Zone program and must be continually updated to reflect the current technology to provide legally defensible airbase noise assessments. These assessments are used to defend the airbase mission from encroachment of developing local communities. New computer controllable units have been commercially developed and integrated into our NOISECHECK II program for use in spot check monitoring that is often required in cases of controversy or litigation. An initial prototype of a noise monitoring network similar to those used in major civil airports was developed using this NOISECHECK capability. It may become necessary for military installations and controversial special use airspace to use these noise monitoring networks to obtain the degree of public acceptance necessary to avoid further operational restraints.

NOISETECH research programs involve laboratory and field studies on the effects of subsonic aircraft noise and sonic booms on both domestic animals and wildlife, including fowl, horses, caribou, bighorn sheep, the desert tortoise, and other species. Specific projects currently underway include development of a domestic animal effects model, a predator-prey interaction model, and a grazing animal model. Draft USAF position papers and assessment models for these efforts will be incorporated into ASAN.

OPR: AL/OEB, (513) 255-3605 [DSN 785]

Health Risk Assessment Program

The Superfund legislation in 1980 created the Agency for Toxic Substances and Disease Registry (ATSDR) as part of the Public Health Service in the US Department of Health and Human Services. ATSDR conducts a Public Health Assessment for every site on the National Priorities List (NPL), also known as the Superfund list. The USAF in 1992 had 33 installations on the NPL for a Public Health Assessment to be performed. ATSDR reviews available information about hazardous substances at a site and evaluates whether exposure to them might cause any harm to people in the past, present, or future.

The Occupational and Environmental Health Directorate of Armstrong Laboratory (AL/OE) initiated the Health Risk Assessment Program to provide the USAF, major commands, and installations a technical center of expertise to assist with ATSDR in the health assessment process. The team of professionals consists of physicians, epidemiologists, toxicologists, bioenvironmental engineers, public health officers, industrial hygienists, and biologists. Members of the team travel to USAF bases on the NPL before the assessment process to preview the hazardous sites and identify where additional environmental data should be collected. During this process, recommendations are made to prevent or reduce personal exposure to hazardous substances. An AL/OE representative then accompanies the ATSDR health assessor during the site visit and assessment. This working association with ATSDR allows for the best flow of information providing a more complete and accurate Public Health Assessment document. This document is then reviewed by the technical experts at AL/OE for validity and accuracy in such areas as toxicology, epidemiology, biological pathways, and health impact to the person.

The AL/OE focal point acts as a liaison with the ATSDR Division of Health Assessment and Consultation. This provides for consistency of the reviews, uniformity to the health assessment process, and technical support to the installations and MAJCOMs. Since the Health Risk Assessment Program is active in the Army and Navy, AL/OE works closely with the sister services to enhance the combined capabilities of toxicology and epidemiology. The USAF has taken the lead for cleaning up the environment in and around our sites, and through this program AL/OE is working to ensure the environment is safe for the public now and into the future.

OPR: AL/OEM, (210) 536-2063 [DSN 240]

Bioenvironmental engineers discuss possible locations of toxic substances.

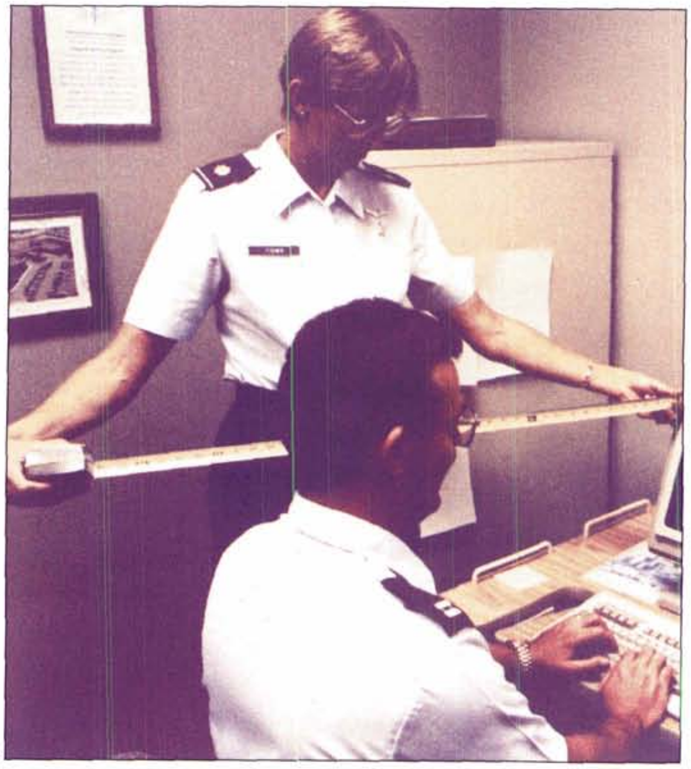
Air Force Ergonomics

Ergonomics related illness has been called the "occupational disease of the 1990's." Impairments of the muscles, tendons, nerves, and joints which occur over time in the workplace are very common; the average employee loses nearly two days of work each year due to disorders of this nature, and "cumulative trauma disorders" now comprise nearly 60 percent of all occupational illnesses reported to the Bureau of Labor Statistics. Ergonomics or the study of the "laws" of work, focuses on selectively adapting the job environment to individual needs. By achieving a close fit between workers and their environment through task, tool, or workstation redesign, the ergonomist hopes to reduce or eliminate many of the common job stressors associated with occupational disease.

In 1990, Armstrong Laboratory initiated the Air Force Center for Ergonomics Consultative Services and Information Exchange. In response to this tasking, a multidisciplinary team, composed of an occupational medicine physician, industrial hygienist, and military public health officer, was established to provide telephone and on-site ergonomics consultations to customers. Since its inception, the team has published ergonomics related technical reports and consultative letters, and conducted ergonomic surveys in a variety of work areas. High levels of cumulative-trauma illness have been identified in USAF sheet metal shops, supply, commissary, and tire shops. Most recently, the team analyzed jobs in a base parachute shop, and made recommendations for administrative and engineering design changes to minimize the ergonomic hazards found in the drag parachute packing areas.

This year, the focus has been on developing the "total program requirements" for implementing a USAF-wide ergonomics program. The Air Force Occupational Safety and Health or AFOSH standard resulting from this endeavor should ultimately have a significant, positive impact on the USAF working environment.

OPR: AL/OEM, (210) 536-2063
[DSN 240]



Measuring the computer station to ensure worker "fit."

Hazardous Waste Analysis Program

The Resource Conservation and Recovery Act (RCRA) mandates that all USAF installations conform to certain requirements to have their waste characterized and disposed of properly. In response to this need, Armstrong Laboratory maintains waste management teams to provide waste management guidance and sampling assistance.

The Human Systems Center also acts as a focal point to provide bases worldwide with an avenue to have potential hazardous waste samples analyzed. Utilizing major command Civil Engineering funds, samples are analyzed by civilian contract laboratories that are the best in the industry. Data provided by these laboratories are forwarded to Armstrong Laboratory for assessment and evaluation by highly trained scientists prior to release to the installation, thus assuring a quality product delivered to our customers.

Complete characterization of a waste is extremely expensive and time consuming. Costs can range from $700 to $2,000 per sample, and analysis can take up to three weeks to perform. Over 45 separate analyses are performed on each sample to determine if they fall into the category of hazardous waste as defined in RCRA.

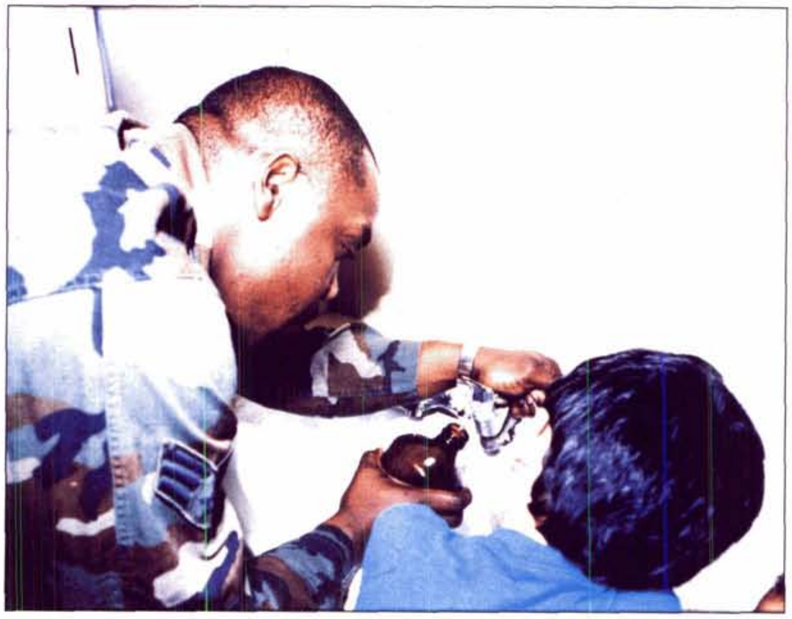
All USAF installations must abide by RCRA. The hazardous waste analysis program is a key in providing bases with the information necessary to dispose of waste safely and economically while avoiding potential costly fines imposed by the Environmental Protection Agency.

Samples are analyzed to identify potential hazardous waste.

OPR: AL/OEA, (210) 536-3626 [DSN 240]

Environmental Sampling

Recent changes to the Water Quality Act, the Clean Air Act, the Safe Drinking Water Act, and the Resource Conservation and Recovery Act require detailed sampling or computer modeling of air, drinking water, and wastewater. The Water Quality Act, also known as the Clean Water Act, requires permits and discharge limitations for industrial waste, sanitary waste, and storm water. The Clean Air Act Amendments require detailed emission inventories of all sources of air pollution and also contain provisions for air emissions permits. The Resource Conservation and Recovery Act rules govern the identification and disposal of hazardous waste material. The Safe Drinking Water Act requires monitoring and treatment when necessary for over 100 contaminants in drinking water.



Sampling for lead testing in a child development center.

Armstrong Laboratory (AL) environmental scientists provide technical expertise survey teams that will travel to bases and perform environmental samplings and unique in-house analysis. Bases experiencing environmental problems can contact a variety of specialized consultants for interpretation of regulations or problem-solving suggestions. On-site environmental surveys are scheduled in a priority fashion based on the urgency of the request, but can take place in a matter of days if necessary.

Most samples collected during on-site surveys are analyzed without cost to the base. The primary source of analytical support is the AL Analytical Services Division. An increasing number of permits require special analysis of samples using fish or minnows. AL can help bases avoid sampling for some air emissions by maintaining the necessary software to perform Environmental Protection Agency approved modeling of air pollution sources.

Environmental sampling teams provide a significant resource to bases in their efforts to comply with today's complex array of environmental regulations. DOD customers include civil engineers and medical personnel in all major commands.

OPR: AL/OEB, (210) 536-3305 [DSN 240]

Lead Based Paint

Armstrong Laboratory (AL) consultants are evaluating military family housing units, child care centers, and youth centers for the presence of lead based paint (LBP). According to the Center for Disease Control, lead poisoning is one of the most common pediatric health problems in the United States today. Potential sources of lead in the environment are lead based paint, industrial emissions, lead in pipes, and lead in food containers. The pathways by which lead from these sources finds its way into the human body include inhalation of air, ingestion of food and drinking water, and ingestion of nonfood solids such as paint, house dust, and soil dust. LBP is the most widespread source of lead exposure to children.

In a typical survey, bioenvironmental engineers and technicians prioritize housing units based on whether children under seven years of age or pregnant woman are presently living in the house, the condition of the paint, and the age of the unit. Units built before 1970 (especially those built before 1950) are more likely to contain LBP. The survey team uses an X-ray fluorescence spectrum analyzer to measure the amount of lead in paint. In addition, the team collects dust samples in each unit and soil samples outdoors. LBP is often found on house components such as door frames, window frames, wooden trims, and exterior walls. Levels of lead dust and lead in soil are generally within the acceptable levels established by the Environmental Protection Agency and the Department of Housing and Urban Development.

AL is now developing USAF technical guidance on LBP investigations and is a member of the DOD Interagency Committee on Lead Based Paint in military housing and other buildings.

OPR: AL/OEM, (210) 536-3214
[DSN 240]

X-ray fluorescence monitoring for lead based paint.

Toxicology Research and Development

Armstrong Laboratory's toxicology research and development defines the toxic hazards associated with fuels, chemicals, and structural materials used in advanced aerospace weapon systems. A multidisciplinary scientific research team examines the mechanisms of toxicity and recommends human exposure criteria. In addition, the team develops new methodology and creates methods to relate data from animals to humans.

Technician performing toxicity assessment on fuel sample.

Toxicology research is vital to the development and acquisition of materials designed to enhance USAF operational capability. Researchers proposed USAF materials to toxicological evaluation, enabling decisionmakers to build acquisition strategies that balance the USAF mission, health risks, environmental factors, and life cycle costs. Recently, nonflammable aircraft hydraulic fluids, new fuels, and lubricants were evaluated for USAF use. This research effort is also substantially involved in a high priority effort to find safe replacement chemicals for halons currently in the USAF inventory.

This research integrates investigations of toxicity ranging from the cellular level of target organs, to whole animals or human systems. The quantitative description of the uptake, distribution, metabolism, elimination, and toxicity of USAF operational chemicals and materials involves the use of kinetic studies, analytical biochemistry, biomathematical modeling, cancer mechanism studies, and cell culture techniques.

USAF toxicology research responds to a spectrum of mission driven needs ranging from rapid relative toxicity screens to long-term chronic inhalation studies. The presence of hazardous materials adds several hundred million dollars to each weapon system's life cycle and increases health risk to personnel. Ongoing research enables reducing both cost and risk to personnel health.

OPR: AL/OET, (513) 255-5740 [DSN 785]

Automatic Mustard Agent Detector

Detection and warning is a key element of preparedness for chemical warfare defensive operations. To operate effectively in a contaminated environment, commanders need to know the type and concentration of the chemical agent, location of the agent, movement and spread of the contamination, and must be alerted when the contamination has been reduced to a safe level. The automatic remotely alarmed detectors currently in use detect only nerve agents and are prone to produce false positive readings from common battlefield contaminants.

Use of mustard agents against a wartime enemy dates back to World War I. Because an increasing number of countries are developing chemical weapons, the Human Systems Program Office is pursuing a fast-track acquisition of a small number of automatic mustard agent detectors for contingency operations. The Finnish M-90 has been selected for this purchase and will be used by specialized teams to determine if the area being monitored at air bases is contaminated. It will also be used to provide a remote chemical detection capability to warn personnel of chemical attack and to monitor the atmosphere in collective protection shelters for the intrusion of contamination. Upon completion of this initial limited buy, a much larger acquisition will continue to meet the requirements for vesicant agent detection worldwide. All devices will provide timely and critical information the commander needs to improve his chemical warfare defense posture while in the battle area.

The M-90 from Finland.

OPR: HSC/YAC, (210) 536-2675 [DSN 240]

Radiation Detectors

Commanders must have a nuclear radiation detection capability to monitor nuclear materials and contamination levels during peacetime and wartime scenarios. Currently fielded USAF radiation detectors are unsupportable. This exposes military bases by providing little or no long-term detection capability. With the addition of the new radiation detector, bases will have the ability to monitor all forms of radiation for extended periods of time.

In an effort to provide a nuclear radiation detection capability, the Human Systems Program Office is conducting a commercial off-the-shelf procurement contract. The fielding of these devices will permit timely detection of nuclear radiation vital to the protection of personnel on the battlefield and in the manufacture, transportation, handling, decontamination, storage, and eventual destruction of nuclear materials. These detectors will improve operational capability in wartime and peacetime missions.

OPR: HSC/YAC, (210) 536-2675 [DSN 240]

USAF Personnel Radiation Dosimetry

USAF personnel work with various types of radioactive materials and radiation-producing machines to include nuclear medicine, radiotherapy, instrument calibration, irradiators, gauges, nuclear weapons, and research and development. The potential for exposure to ionizing radiation is present which necessitated the establishment of national standards to minimize the risk associated with exposure to ionizing radiation. The danger of ionizing radiation to USAF personnel is minimized through the proper use of personnel dosimetry.

The USAF's large-scale personnel radiation exposure monitoring program utilizes state-of-the-art software, hardware, and dosimetry to ensure the protection of the worker. Physicians, dentists, weapons inspectors and handlers, non-destructive inspection operators, and reactor operators are some of the occupations that are monitored. The system is considered to be reliable, accurate, and technically advanced.

Success of the program is essential for positive proof of compliance with Air Force Regulation 161-28 and Title 10, Code of Federal Regulations, part 20. The USAF participates in the National Voluntary Laboratory Accreditation Program (NVLAP) administered by the US Department of Commerce, National Institute of Standards and Technology, formerly the National Bureau of Standards. We have fulfilled the requirements for this certification and continue to maintain this level of proficiency in all eight categories. The Instrument and Calibration facility supports the personnel dosimetry program by providing periodic calibration of the thermoluminescent dosimeters in order to maintain a high level of quality assurance as required by NVLAP.

OPR: AL/OEB, (210) 536-3486 [DSN 240]

Reading dosimeters to determine ionizing radiation exposure of USAF personnel.

In Vivo Bioassay

Personnel who routinely use radioactive materials can inadvertently inhale or ingest these materials. To determine the amount of radioactive material internally deposited, Armstrong Laboratory utilizes a combination of instruments and procedures.

In vivo activity of gamma-emitting radionuclides is determined by using a Canberra Accuscan II Whole Body Counter (WBC). The WBC provides quantitative and qualitative determination of the radionuclide body content of potentially exposed personnel. After the ingested or inhaled activity has been determined, specialized software is used to determine the cumulative dose that is expected over the next 50 years (the committed effective dose equivalent, [CEDE]). This CEDE is then entered into the USAF Master Radiation Exposure Registry (MRER), which is maintained as a historical dose record database at Armstrong Laboratory.

Armstrong Laboratory routinely provides radioanalytical support to all the armed services in addition to the Department of Energy. This in vivo bioassay capability establishes Armstrong Laboratory as the premier radioanalytical laboratory within the DOD.

OPR: AL/OEB, (210) 536-2061 [DSN 240]

Measuring internal radiation exposure to determine short- and long-term health effects.

Environmental Bioassay

The Ecology and Bioassay Function in the Occupational and Environmental Health Directorate of Armstrong Laboratory provides aquatic and soil bioassay support for bases USAF-wide. Bioassay tests statistically compare a test organism's response to a potential contaminant versus the organism's response to an uncontaminated control. While chemical analysis can provide useful data on the make-up of contaminated water, soil, or products, only a bioassay can assess the actual hazard it may present to living things in the environment.

The Ecology and Bioassay Function uses fathead minnows (Pimephales promelas), water fleas (Ceriodaphnia dubia), algae (Selenastrum capricornutum and Photobacter phosphoreum) as test organisms for aquatic bioassays, sorghum (Sorghum bicolor), and pinto beans (Phaseolus vulgaris) for soil bioassays. Although most bioassays take several days to accomplish, the function capabilities include a computerized bioassay system called Microtox TM, which completes a bioassay in about 30 minutes.

Many bases have legal requirements for bioassays under their National Pollutant Discharge Elimination System permits. Other bioassays are requested for investigations of fish kills, lawsuits involving farming lands contaminated by fuel or oil spills, and investigations of the environmental impact of products used by the USAF, such as aircraft deicers. The Ecology and Bioassay Function complies with the Environmental Protection Agency and the most stringent state guidelines. In FY92, the function completed over 200 bioassays in support of 17 USAF installations. The Ecology and Bioassay Function provides USAF installations with a cost-effective alternative to contracting these services, some of which cost thousands of dollars per individual test and could add up to hundreds of thousands of dollars per year at a single installation.

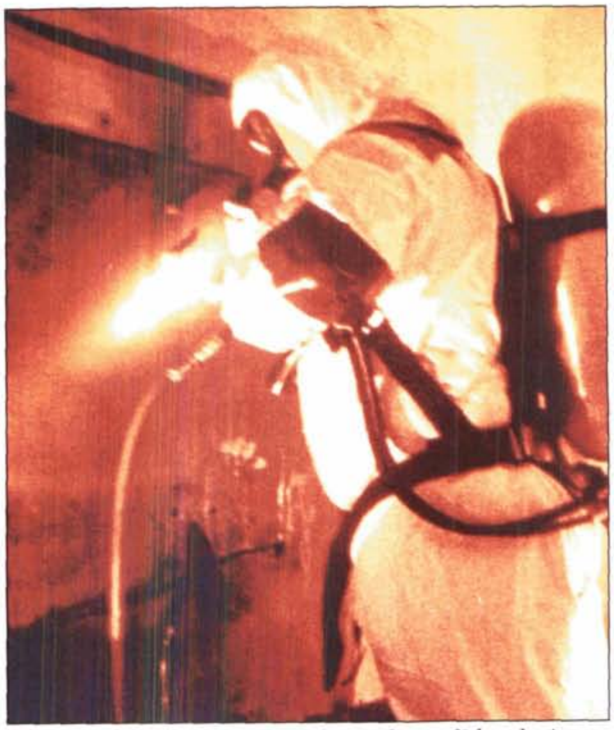
OPR: AL/OEM, (210) 536-3214 [DSN 240]

Culturing organisms for bioassay.

Air Force Radiation Assessment Team

The Air Force Radiation Assessment Team (AFRAT), based at the Armstrong Laboratory, provides assistance worldwide for on-site detection, identification, and quantification of any ionizing radiation hazard. AFRAT stands ready in the event of a nuclear weapon accident or any incident involving the potential release of radionuclides. The AFRAT team consists of 34 extra duty personnel which includes health physicists, bioenvironmental engineers having expertise in industrial hygiene and environmental quality, bioenvironmental engineering technicians, radioanalytical laboratory technicians, a radiochemist, and an occupational health physician. AFRAT is capable of deploying to any location worldwide within 48 hours, and provides a full range of equipment and consultation to the on-scene commander in health physics, industrial hygiene, and environmental quality.

Recently, AFRAT deployed to Loring AFB ME and Keesler AFB MS. At Loring AFB, workers cutting into an abandoned and sealed weapons storage facility were potentially contaminated with radioactive material. Subsequent measurements made by AFRAT determined that the source of the contamination was naturally occurring radon gas which had accumulated in the facility due to poor ventilation. AFRAT determined that personnel involved in the initial entry of this facility were not adversely affected by the radon gas thereby avoiding widespread public concern. Follow-on AFRAT actions at Loring AFB included the development and implementation of a comprehensive health and safety plan which ensured a radiologically safe entry into the facility. At Keesler AFB, a garbage truck was turned away from the local landfill after landfill officials detected unknown radioactive material in the waste. The AFRAT succeeded in locating, identifying, and segregating the suspect material. Keesler and state environmental officials were impressed with the AFRAT's quick response and thoroughness.



AFRAT member monitoring for radionuclides during building entry operations at Loring AFB, Maine.

AFRAT provides a specialized team for radiological monitoring and assessment at any place and time. AFRAT's readiness posture is exemplified by its deployments. The interagency response community can depend upon AFRAT to set the standard for response and to retain its position as one of DOD's premier radiological accident/incident response forces.

OPR: AL/OEB, (210) 536-3486 [DSN 240]

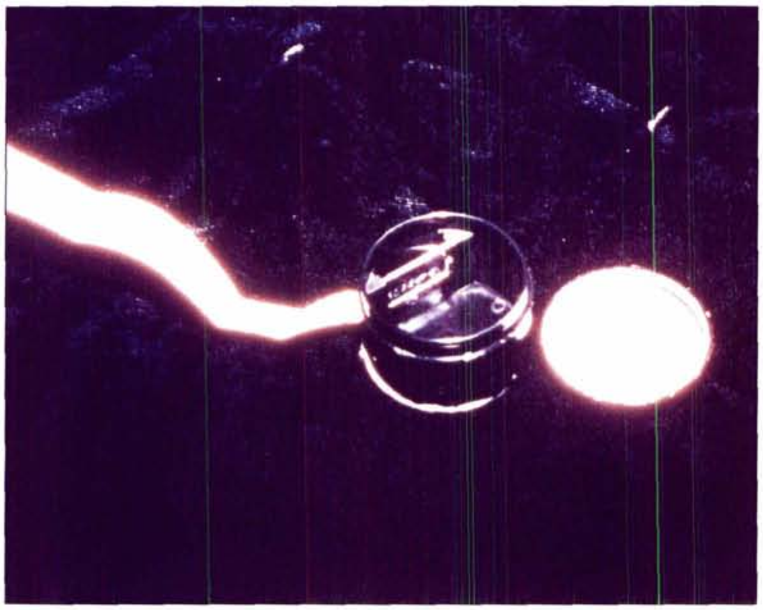
Radon Assessment and Mitigation Program

Radon, a naturally occurring radioactive gas produced by the decay of uranium, is second only to cigarette smoking as a cause of lung cancer. The Environmental Protection Agency (EPA) estimates radon causes 5,000 to 20,000 lung cancer deaths per year in the US. Elevated concentrations of radon in homes are widespread. An EPA survey of 25 states found one in four homes tested had elevated levels. In response to this concern, Congress enacted Title III of the Toxic Substance Control Act (also called the Indoor Radon Abatement Act) in 1988, which requires testing of all federal facilities for radon. Prior to enactment of this legislation, the Armstrong Laboratory's Radon Assessment and Mitigation Program (RAMP) had already been implemented and accomplished 5,000 screening measurements at 135 USAF installations worldwide.

As a result of the screening measurements, 51 installations were targeted for year-long measurements of all residential, school, child care, and lodging structures. Of the approximately 46,000 measurements made thus far, 14 percent are above the EPA screening level. Structures identified as having radon levels exceeding the EPA level will require mitigation. In early 1993, measurements of administrative structures began at previously identified installations which are not on the base closure list. Mitigation in response to RAMP measurements is ongoing at several installations.

RAMP efforts have been proactive from the start, and RAMP continues to serve as a model for other agencies. RAMP efforts will reduce the long-term risk of lung cancer from exposure to radon for personnel living and working on USAF facilities.

OPR: AL/OEB, (210) 536-3486 [DSN 240]



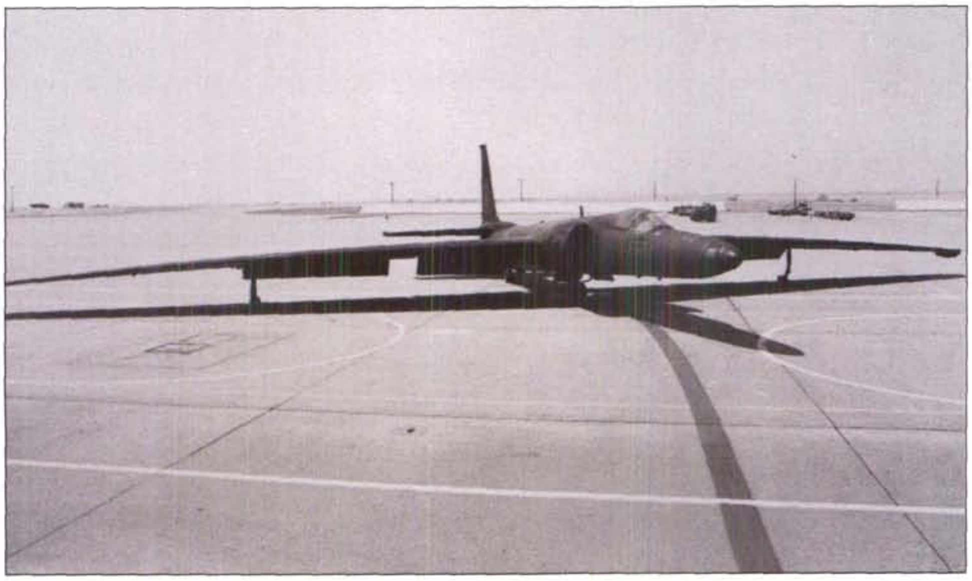
The Tech-Ops/Landauer Alpha Track "RadTrak" radon detector is a passive monitor for radon levels.

High-Flier Radiation Dosimetry Program

High altitude aircrews risk exposure to relatively high levels of naturally occurring ionizing radiation. The sources are cosmic and solar particles and their associated secondary radiations produced by interaction with the Earth's atmosphere. Under normal conditions, at high latitudes and altitudes above 40,000 feet, dose rates can reach levels on the order of rem per hour experienced during a major solar flare.

In an effort to more accurately assess the operational radiation environment and exposure to high altitude aircrews, the Air Combat Command and the Armstrong Laboratory have entered into a collaborative program to conduct radiation measurements on U-2 aircraft. Several total dose meter instruments (TDM) are under construction which will be flown routinely on U-2 missions. Detectors used will be tissue equivalent proportional counters. The TDMs will have a multichannel analyzer to register the particle spectrum. A large-scale memory will sequentially store the data and dose as a function of flight time for analysis of flight dose profiles. An LED warning feature will also alarm at a preset radiation level.

The radiation data collected will provide a database from which rapid and accurate radiation risk estimates required for military and contingency planning can be made. The dosimetry technology developed and used in this program will help decrease human health risk in these operational environments.

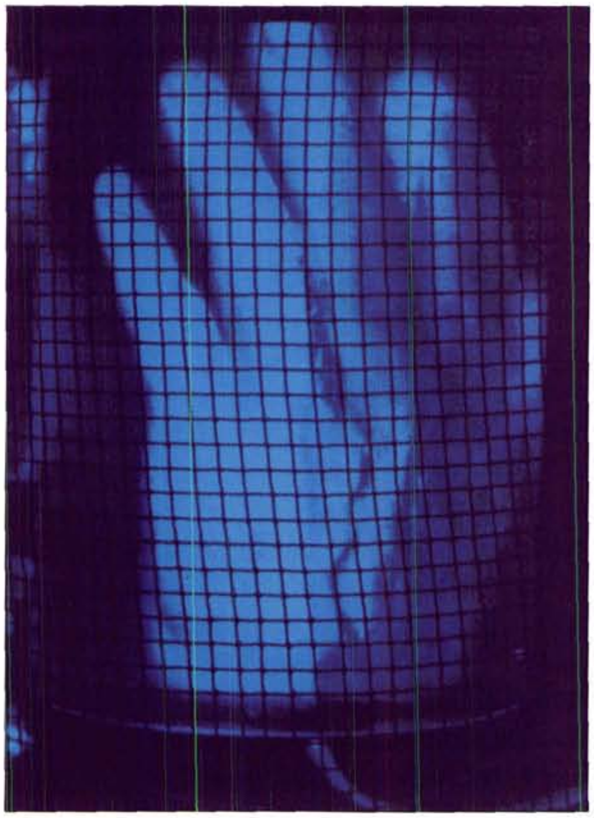


Radiation meter will measure U-2 pilot doses.

OPR: AL/OEB, (210) 536-3486 [DSN 240]

Radiofrequency Radiation Assessment

Many USAF systems produce nonionizing electromagnetic radiation. Human Systems Center researchers are improving current methods to measure radiofrequency radiation (RFR). One revolutionary approach, Thermochemiluminescent Radiofrequency Radiation Microdosimetry (TRM) uses a combination of hardware, software, and chemistry to determine the absorption patterns of RFR in models of the human body. With TRM, a plastic anthropomorphic phantom is filled with a light emitting polymer and exposed to RFR. The measured luminescence of the polymer indicates the level of absorption of the RFR signal. Because the emitted light is imaged, a map of the microdistribution of the absorbed energy is obtained in near-real time.



Human-hand phantom containing tissue simulant that luminesces.

This light emitting polymer was invented by Armstrong Laboratory (AL) researchers (US Patent 5,003,050). AL researchers have invented a biosynthetic method (patent application filed) for producing the polymer in bacteria using fermentation technology. This has made RFR dosimetry possible even in single cells. The luminescence is detected, quantified, and displayed using the USAF Quantitative Luminescence Imaging System (QLIS) on the human phantom and microscopic scale (US Patent 4,948,975). Researchers are now developing anthropomorphic phantoms capable of being placed in various postures since these geometric factors affect the amount and distribution of RFR energy absorbed.

This new technology replaces a time-consuming procedure requiring many consecutive point-by-point measurements. Critical information on RFR exposures in the workplace will be more accurate and cost-effective. In addition, this technology will result in significant new applications in civilian medical and industrial applications of RFR such as hyperthermia treatments of diseases, luminescent labeling in diagnostics, and the heat-curing of materials using radiofrequency energy.

OPR: AL/OER, (210) 536-3176 [DSN 240]

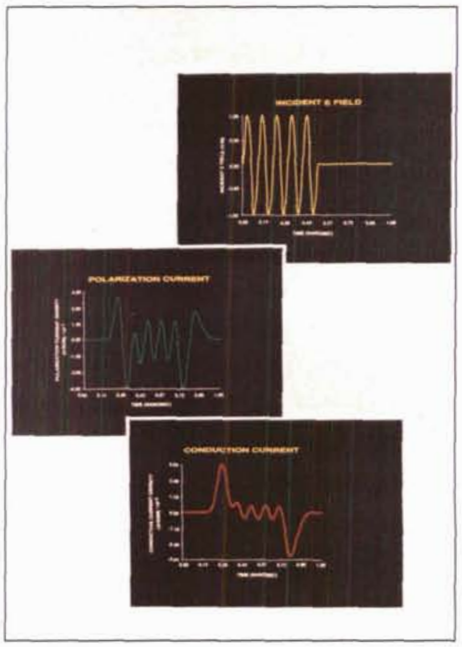
Computational Bioelectromagnetics

Ultrashort directed energy microwave and laser systems are evolving rapidly in accordance with the USAF Directed Energy Master Plan. These systems produce intense short-lived pulses of electromagnetic energy which previously have not been seen in nature. These unique and intriguing physical events represent a concern from the human health and safety point of view, and they represent an exciting and very deep opportunity to explore new classical physics' and biomedical physics' principles and applications.

In response to the health, safety, and applied science challenge and opportunity posed by the development of ultrashort pulsing devices, Armstrong Laboratory (AL) has instituted an electromagnetic computing and mathematical physics research program. This program studies the propagation of very high peak power microwave and laser pulses through living tissue. When these pulses enter tissue, they strongly couple to the charged chemical structures which are part of living cell membranes and to other key molecular structures such as enzymes, DNA (the genetic material), and RNA. The charged components of these biomolecular entities are mechanically driven by the propagating pulses, and the resulting movement of the charged components sets up a reactive electromagnetic field.

Research in the newly formed AL effort is proceeding toward an understanding of short pulse propagation in living tissue. In-house mathematical and physics researchers have defined the existence of large electric field transients produced in living tissue by impinging short pulses. In the past year, electric currents induced in tissue by electric field transients have been computed for the first time ever in the history of electromagnetic research. These currents are of two types: a conduction current that corresponds to the translational movement of free ions in the tissue material and a polarization current that corresponds to the perturbation of charges that are bound to membrane, enzyme, or other biomolecular structures. The figure shows the polarization and conduction currents induced by a one-volt-per-meter square wave modulated pulse striking a tissue surface (the incident signal). Note that the induced polarization current is substantial, being amperes per square meter in order of magnitude. A small portion of the total current is conductive in nature. It remains for future research to delimit the possibly differing biological effects of the two current flows.

OPR: AL/OES, (210) 536-3884 [DSN 240]



Tissue model current response to a 1 v/m incident pulsed field at a depth of 1 cm.

Delayed Radiation Effects in Aerospace Operations

Future aerospace missions such as high-flying USAF surveillance activities, National Aerospace Plane, Space Shuttle, Space Station or Lunar Base, will involve increased radiation exposures due to high altitude or high-latitude orbits as well as longer missions outside the protection of the geomagnetic fields. Increased hazards to personnel will require radiation-protection measures based on in-depth knowledge of the risks. Exposure to ionizing radiations is associated with higher probabilities of developing cancers and visual cataracts as well as lowered life expectancy. The Delayed Radiation Effects research program was designed to assess the long-term radiation risks for personnel in aerospace operations and will develop practical guidelines for crew protection.

Resolution of health risk problems associated with late effects of space radiations is best achieved by studying long-lived physiological models. Our research on radiation-induced cancer, cataracts, endometriosis, and genetic (chromosome) damage in a model system close to man will help define parameters in such areas as spacecraft and aircraft shielding design. In addition, spinoffs from the ionizing radiation research project, especially in the area of genetics, will have an impact on investigations of late effects of chemicals and other environmental toxins to which personnel may be exposed on the surface of the earth; for example, in base cleanup operations.

The 30-year space radiation biology database provides for rapid and accurate radiation risk assessments required for military decisions and contingency planning. The development and applications of dosimetry technology and evaluations of late radiobiological endpoints will help decrease short- and long-term human health risks and ensure the highest probability of mission success.

OPR: AL/OER, (210) 536-3416 [DSN 240]

Molecular probes for human chromosomes which detect aberrations in monkey cells following irradiation with protons.

Initial Development of Roadmap for Radiological Detection: Concept Study

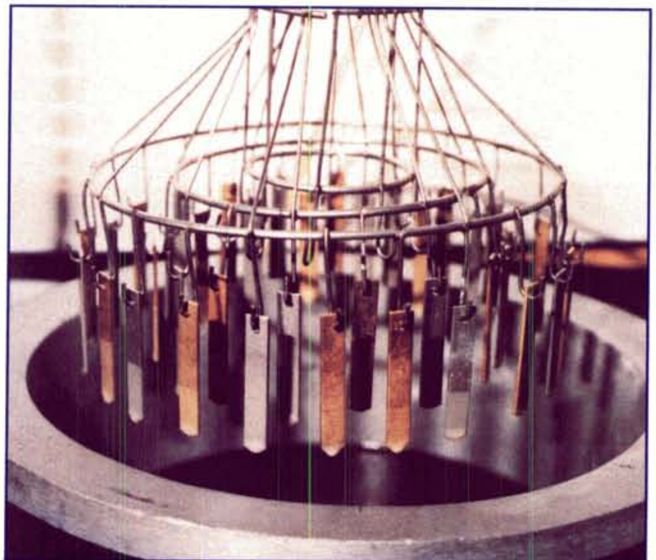
Despite changes in the geopolitical environment, the USAF must remain technologically current to adequately support personnel during both peacetime and wartime situations. One area in dire need of technology refreshment is radiological detection. Current radiological detection equipment is obsolete, is limited in capability, and requires excessive maintenance. This situation must be remedied to meet projected USAF requirements.

The Radiological Detection study will meet USAF requirements by determining our current capabilities and what we must do to meet our future requirements. There are four major objectives of this study. First, identify and summarize the current operational radiological detection equipment throughout DOD. Second, identify and summarize radiological detection related research and development throughout DOD. Third, develop initiative programs to eliminate technology gaps and meet USAF requirements. And fourth, develop an implementation plan (i.e., roadmap) for the initiative programs. The results of this effort will ensure the USAF can meet future demands.

OPR: HSC/XRS, (210) 536-2424 [DSN 240]

Candidate radiation detection devices are currently under review.

Environics



This Human Systems Center product area provides environmental quality technology that supports the Air Force mission by reducing the cost of cleaning up past waste sites while assuring, through compliance, the completion of critical wartime and peacetime missions. Environmental Quality efforts at Tyndall AFB, Florida, center on low cost highly effective ways to prevent environmental problems and to restore existing facilities.

Microorganisms Used in Biodegradation

To address the need for an effective and inexpensive groundwater treatment technology, researchers at this laboratory have isolated a strain of Pseudomonas bacteria which readily destroys complex pollutant mixtures. In laboratory tests, the microorganism converts these contaminants to harmless materials such as water, carbon dioxide, and chlorides. In bench scale experiments, complex mixtures of solvents were reduced to nondetectable levels in 30 minutes.

After extensive fundamental research on the metabolic capabilities of the microorganism, scientists tested the concept in the field to determine its applicability to USAF pollution problems. A pilot plant bioreactor was tested at Kelly AFB TX, where the soil and groundwater in an abandoned waste storage area had been contaminated by various solvents and chemicals.

Preliminary tests were conducted on groundwater under a variety of operating conditions. The system reduced concentrations of benzene, toluene, chlorobenzene, and dichlorobenzene from parts-per-million level down to the parts-per-billion level when the reactor was operated at a 40-minute retention time. Results are being evaluated for use in an Installation Restoration Program feasibility study for cleanup of this site. A second field test is planned to collect additional operating data for use in the design of a full-scale system.

This technology can be used for more effective pump-and-treat remediation at any installation where groundwater has been contaminated by aromatic solvents and chemicals, and where economic cleanup and site restoration are imperative. Biodegradation offers an effective inexpensive treatment alternative to traditional physical and chemical treatment technologies. Although the technology can be widely used by the USAF and DOD, its technology transfer potential to the private sector is even greater. Knowledge gained from these studies will result in more effective pump-and-treat remediation and may lead to later use of Pseudomonas strains for biodegradation of aromatic solvent compounds on an in situ basis.

OPR: AL/EQ, (904) 283-6272 [DSN 523]

Biodegradation studies.

Bioventing for Enhanced Biodegradation

Soil bioventing is a modification of soil venting technology which is used to treat contaminated soil. Soil venting pulls air through a perforated well in the contaminated zone, using a vacuum pump system. Air can enter passively through an open well or be injected through a well. The air flow volatilizes and removes the contaminants bound to the soil and provides oxygen to the soil bacteria. Air Force Civil Engineering Support Agency (AFCESA) first conducted a small-scale test of bioventing technology at a jet fuel contamination site in a sandy permeable aquifer at Tyndall AFB FL. Goals included optimizing the amount of hydrocarbon removal by in situ biodegradation while minimizing the volatilized hydrocarbons given off in the vented airstream. The effect of adding nutrients and moisture to the subsurface to stimulate bacterial growth was also studied. Operating the bioventing system under optimum conditions resulted in 85 percent hydrocarbon removal by in situ biodegradation. A full-scale demonstration of bioventing was done at Hill AFB UT and a feasibility study is underway at Eielson AFB AL to determine the applicability of bioventing in a subarctic environment. To expand the range of sites where bioventing can be used, a large-scale test will be conducted in the northern US under less permeable conditions. Results indicate this may be a low cost, highly effective remediation technique that is transferable to the public. The Air Force Center for Environmental Excellence is transferring this technology by implementing bioventing as a cleanup technology at 50 USAF sites.

OPR: AL/EQ, (904) 283-6272 [DSN 523]

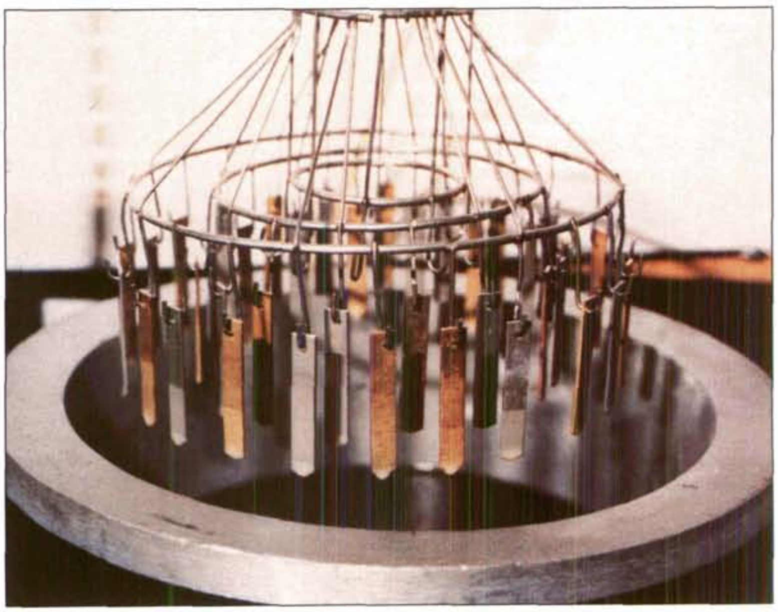
Bioventing under Arctic conditions.

Biodegradable Solvents and Cleaners

Solvents and cleaners are used at the USAF air logistics centers and base level aircraft maintenance facilities for degreasing and removing wax and paint before repairing or electroplating the parts. Most solvents are toxic and combustible. Many, such as the 1,1,1-trichloroethane used in vapor degreasing, cannot be treated with biological processing methods used in most Industrial Waste Treatment Plants (IWTP). Waste from the process must be placed in drums and shipped elsewhere for disposal. Other solvents such as chlorofluorocarbon-113 (CFC-113 or Freon-113) and perchloroethylene will soon be placed under stricter EPA control because of their potential ozone-depleting effects. The Air Force Civil Engineering Laboratory's (AFCEL) program identifies both solvents replaceable with biodegradable products and the biodegradable solvents that can be used and develops implementation procedures. Solvents were screened for biodegradability, cleaning efficiency, and corrosiveness. Of 40 solvents passing cleaning and biodegradability tests, ten passed the basic test criteria; five survived further testing. Other evaluations include economics, solvent life, process control, and whether replacement solvents create an increased organic load that adversely affects biological treatment. Testing is underway to demonstrate the solvents and processes on aircraft parts being overhauled at Oklahoma City Air Logistics Center. Results indicate that effective biodegradable solvents are available that can be treated in the IWTP system.

In addition to the Biodegradable Solvents research program, AFCEL co-sponsored the annual International Workshop on Solvent Substitution. This joint conference with the Department of Energy brings together experts from government and industry to ensure the successful transfer of solvent substitution technologies. The first two workshops took place in Phoenix, Arizona, and have been hailed as the foremost conferences on hazardous waste minimization through solvent substitution.

OPR: AL/EQ, (904) 283-6272
[DSN 523]



Metal tabs used to test solvent-cleaning capabilities.

Solid Rocket Propellant Disposal Program

Armstrong Laboratory is developing safe environmentally acceptable alternatives to the open burning and open detonation (OB/OD) of solid rocket propellants. The only methods currently available for disposal of ammonium perchlorate (AP)-based, solid rocket propellants are OB/OD or static firing. During these procedures, the burning propellant produces toxic corrosive hydrogen chloride (HCl) gas. This production of toxic gas and the dispersion of unburned propellant from OB/OD are environmentally unacceptable.

The program plan will develop a disposal process for the elimination of Class 1.1 and Class 1.3 propellants generated from the manufacture, maintenance, refurbishment, and disposition of Air Force missiles. The plan addresses three critical aspects of propellant disposal: removal of the propellant from the motor casing, pretreatment of the propellant for processing, and recovery and disposal.

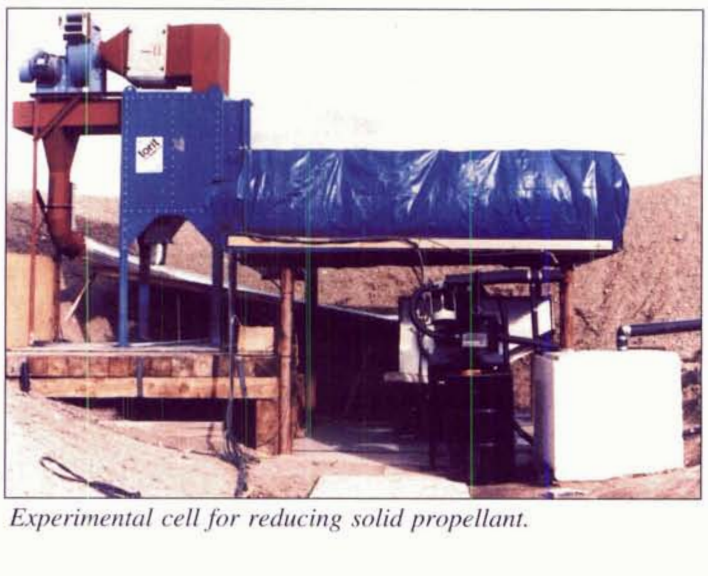
For Class 1.3 propellants, extraction and reclamation of propellant ingredients proved the most desirable disposal method because it reclaims strategic ingredients for resale and reuse (aluminum and ammonium perchlorate).

Hot water dissolves the ammonium perchlorate from propellant components. Filtering the solution removes any entrained solids, after which the pure ammonium perchlorate crystallizes as the liquid cools. The crystals are recovered as a wet cake. Oxidizing the remaining binder material leads to the recovery of the aluminum as aluminum oxide. Waste, which contains dilute concentrations of AP, can be biodegraded and sent to the sanitary sewer or discharged. Indeed, if ammonium perchlorate recovered in this manner meets or exceeds military specification standards for virgin material, it may be reclaimed and sold.

No nonpolluting method exists to safely remove and dispose of Class 1.1 propellants [which contain mass detonating ingredients such as nitroglycerine (NG), cyclotetramethylenetetra-nitramine (HMX), and nitrocellulose]. Our proposed process removes the propellant from the motor casing and converts it into a powder. The powder is washed, separating the soluble AP and NG from the insoluble HMX, nitrocellulose, aluminum, and binder. The AP/NG solution is reduced to chloride and nitrogen gas prior to reducing the carbon content and discharging to the sanitary sewer. The insoluable mixture is oxidized to carbon dioxide, water, nitrogen, and solid salts.

A bioreactor is now demonstrating biodegradation of rocket fuels. A joint effort is planned with this laboratory and other DOD agencies cooperating to solve this problem. The program, useful both in DOD hazardous waste disposal programs and in solving applicable NASA problems, is need driven and highly transferable.

OPR: AL/EQ, (904) 283-6272 [DSN 523]



Experimental cell for reducing solid propellant.

134 *Technology Transfer*

To derive maximum return on our country's technology investments and enhance US competitiveness, Congress has passed legislation to encourage the transfer of federally funded or originated technology to the private sector. Most recently, the Federal Technology Transfer Act of 1986 provided significant new authority for the USAF laboratories to enter into Cooperative Research and Development Agreements (CRDA) with private companies and public nonprofit organizations, and to negotiate license agreements of intellectual property on behalf of the government.

CRDAs provide an easy way for industry and nonprofit organizations such as academia to collaborate with USAF research and development activities to facilitate technology transfer for the technological and financial benefits of both parties. The USAF benefits by:

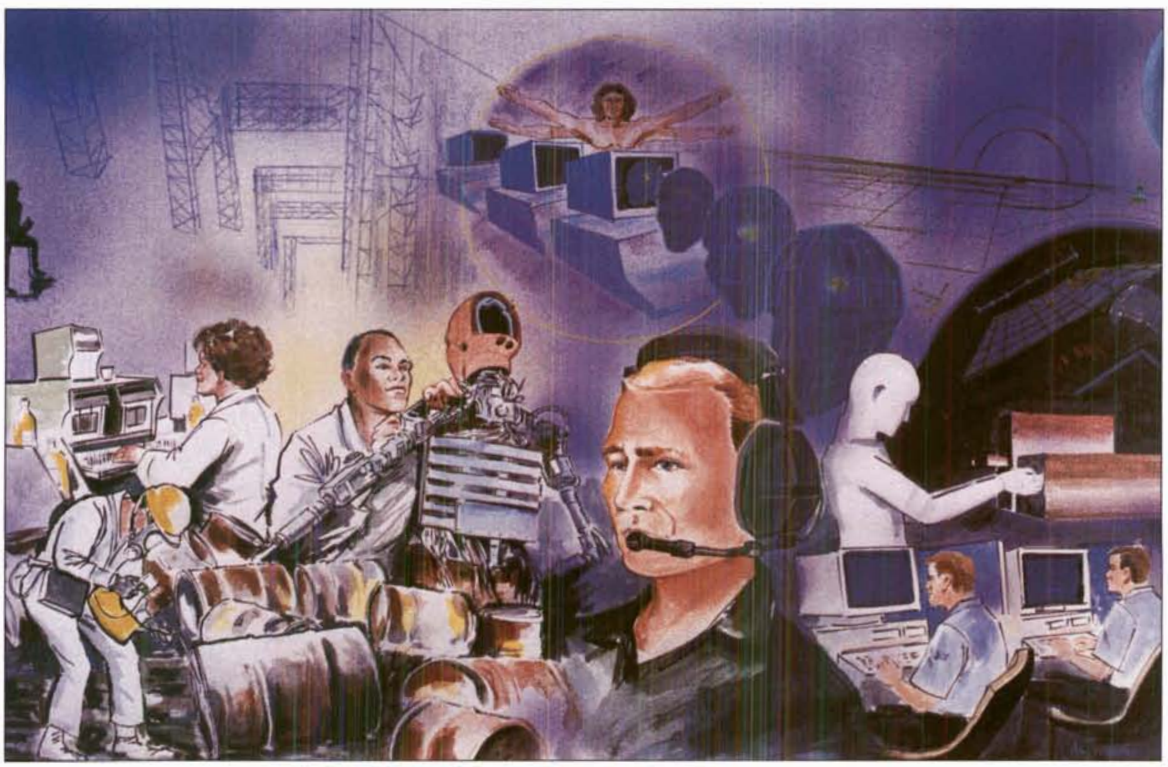
- Improved opportunities to develop and transfer technology
- Accelerated interaction with industry to transfer basic research findings to the commercial development process
- Increased familiarity with market needs
- Sharing of royalty income with the inventors and the laboratory

The collaborating organization benefits by:

- Improved access to USAF scientists and facilities
- Better access to expertise related to research results and inventions
- Options to exclusive licenses on inventions made under the CRDA
- Profitable new products and processes

Many Armstrong Laboratory technologies have near-term potential for CRDAs or license agreements, which include many technologies contained in this book, plus additional technologies available through the Armstrong Laboratory Office of Research and Technology Applications (AL/XPTT).

OPR: AL/XPTT, (210) 536-3817 [DSN 240]



Systems Acquisition School

The Air Force Materiel Command (AFMC) has a legacy of being a DOD leader in acquisition techniques and processes. To instill and maintain this excellence, formal education and training is viewed as a key component. Two thrusts are currently pursued, professional accreditation training for the Acquisition Professional Development Program and command unique acquisition training for specific AFMC needs. To meet these thrusts, AFMC sponsors a command unique acquisition "school house."

The Systems Acquisition School (SAS) provides critical acquisition education and training. Most courses are one-to-two weeks long and are provided in a resident interactive format. However, to meet command needs, any SAS course may be requested for a "road show" offering. The school is "self-contained" providing curriculum development, instruction, and full registrar services. Field experts are recruited from across the command for a tour of instructor duty -- the instructors are known for being top in their respective arenas. The school relies on these experts to teach. The benefit for AFMC is a quick response, expert training resource which can provide solid acquisiton fundamentals and also adapt to the fast changing DOD and AFMC acquisition environments. The Systems Acquisition School stands ready to support command acquisition training needs.

Courses offered (subject to change) are:

Computer Resource Acquisition Course
Subcontract Program Management
Intermediate Systems Acquisition Management
Work Measurement in Pricing Applications
Laboratory Acquisition Management Course
Integrated Product Support Course
Basic Systems Acquisition Management (Medical)

OPR: 615 SCHS/CC, (210) 536-2623 [DSN 240]

Training excellence: A resident interactive session.

Studies and Analysis

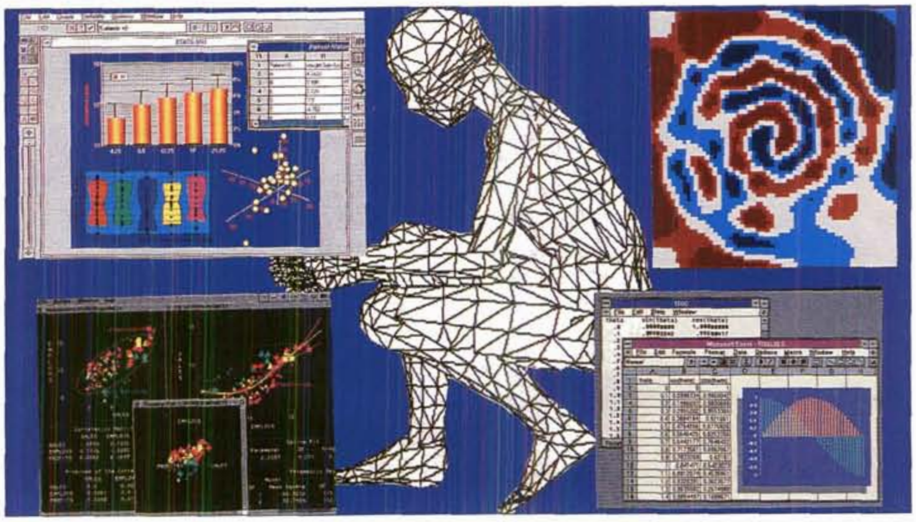
Operational requirements have historically focused more on hardware parameters than on human performance. This man-machine imbalance always produces increased costs and reduced mission effectiveness. The Human Systems Center's Studies and Analysis Division (HSC/XRS) helps users acquire human enhancing technologies that optimize mission performance. Examples of HSC/XRS services include:

- Pre-acquisition requirements analysis to identify human and environmental impacts of new/ changing defense systems, missions, threats, or deployment and support concepts
- Assess the potential of emerging human systems technologies to meet user operational requirements
- Develop/evaluate analytically derived operational systems concept options based on emerging technologies
- Provide data and decision aiding tools that help users select optimal man-machine systems requirements

HSC/XRS's modeling and simulation capability is being expanded to improve quality, scope, and responsiveness of its services. This increased capability will also support:

- Process improvement studies to enhancing a unit's ongoing internal operations
- Strategic planning studies to help focus HSC's technology base towards its customer's long range needs

OPR: HSC/XRS, (210) 536-4452 [DSN 240]



HSC's Studies and Analysis Division is often the first step towards enhanced mission performance.

Organization Functional Statements

HQ Human Systems Center

Works with customers to enhance our warfighters' competitive edge by providing superior human-centered technology, systems, education, and support. We are the systems' independent advocate for the human in design, deployment, and operation of aerospace systems.

Human Systems Program Office

Enhances USAF ground crew and aircrew survival and performance through advanced development, engineering and manufacturing development, production, and operational support of human-centered systems and equipment. This includes life support equipment, aircraft escape systems, crew station equipment, computer based training and intelligent tutor systems, nuclear/biological/chemical defense systems, aeromedical systems and equipment, AF uniforms/clothing, mishap and analyses, and environmental technologies.

Armstrong Laboratory

Plans, manages, and conducts research, advanced technology development, and specialized operational support for the readiness, maintenance, protection, and extension of human capabilities in USAF weapons systems and operations. Functional responsibilities include environmental quality, occupational and environmental health, crew-systems integration, aerospace medicine, and human resources.

USAF School of Aerospace Medicine

As the center for aerospace medicine education, the USAF School of Aerospace Medicine is the major provider of educational programs involving aviation, space, and environmental medicine for USAF, DOD, and Allied Nations personnel. The programs span entry level through graduate medical education in all disciplines encompassed in the aerospace medicine specialty.

615th Systems Acquisition School

Responsible for advancing the education of acquisition professionals in development and acquisition policies and processes, to support and sustain all USAF weapon systems.

648th Air Base Group

Operates and maintains Brooks AFB and provides base element support to Human Systems Center, three USAF Field Operating Agencies, tri-service laboratories and the USAF School of Aerospace Medicine. Support includes, but is not limited to, plans, civil engineering, communication and computer systems, transportation, supply activities, child development, recreation, base security, mission support, command post and family support programs.

Points of Contact

(as of October 1993)

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Chairman, Dept of Aerospace Nursing - USAFSAM/AN Col Karen D. Kimmel	(210) 536-3894 [DSN 240]
Chairman, International Training Services - USAFSAM/IT Mr. Zvonimir Lisac	(210) 536-2646 [DSN 240]

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Article Listing

Document Separator

Brooks Air Force Base

The Center For Human Systems Technology

The Center For
Human Systems Technology

OVERVIEW

- MISSIONS
- HIGH LEVEL SUPPORT
- DOD PROPOSAL
- AN ALTERNATIVE
- COMPARISONS
- SUMMARY

MISSIONS

- HUMAN SYSTEMS CENTER
- HUMAN SYSTEMS PROGRAM OFFICE
- ARMSTRONG LABORATORY
- SCHOOL OF AEROSPACE MEDICINE
- CENTER FOR ENVIRONMENTAL EXCELLENCE

AN INTEGRATED HUMAN SYSTEMS CENTER

HIGH LEVEL SUPPORT

"The Human Systems Center people and organization have figured quietly yet significantly in the success of the air mobility mission." [Referring to Desert Shield/Desert Storm]

- General Ronald Fogelman, Chief of Staff, USAF

"I think one of the major benefits we all get from having an outfit like Human Systems Center on the team, is versatility...from having the ability to respond quickly to find a solution to virtually any problem in its many areas of expertise."

- General Michael Loh, Commander, Air Combat Command

"We must get the most out of our weapons and the people who use them. The Human Systems Center and Armstrong Laboratory are key partners in this rapidly changing world."

- Maj. Gen. Bruce Fister, Commander, Air Force Special Operations Command

THE BOTTOM LINE

- THE BROOKS MISSIONS WILL BE RETAINED
- THEY WILL BE CONDUCTED SOMEWHERE
- MORE COST-EFFECTIVE IN SAN ANTONIO

ONE-OF-A-KIND BIOMEDICAL COMMUNITY

- UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER
- TEXAS RESEARCH AND TECHNOLOGY FOUNDATION
- SOUTHWEST RESEARCH INSTITUTE
- SOUTHWEST FOUNDATION FOR BIOMEDICAL RESEARCH
- WILFORD HALL MEDICAL CENTER
- BROOKE ARMY MEDICAL CENTER
- UNIVERSITY OF TEXAS AT SAN ANTONIO
- AIR EDUCATION AND TRAINING COMMAND

COMPARISONS

	DoD Proposal	Alternative
• SCENARIO	RELOCATE	CANTONMENT
• BROOKS AFB	CLOSE	CLOSE
• PEOPLE		
•Eliminate	391	391
•Relocate	3,228	518
• ONE TIME COST	$ 185 Million	$ 11 Million
• 20 YEAR NET PRESENT VALUE	$ 142 Million	$ 301 Million
• RETURN ON INVESTMENT	7 Years	Immediate

DoD PROPOSAL

- CLOSE BROOKS AFB
- RELOCATE TO WRIGHT PATTERSON AFB
  - * Human Systems Center
  - * Armstrong Laboratory
  - * School of Aerospace Medicine
- RELOCATE TO TYNDALL AFB
  - * Air Force Center for Environmental Excellence
- RELOCATE TO KELLY AFB
  - * 68th Intelligence Squadron
- RELOCATE TO LACKLAND
  - * 710th Intelligence Flight
  - * Hyperbaric Chamber Operation
- RELOCATE TO BASE X
  - * Air Force Drug Test Laboratory

• MOVES		3,228 People
• ONE-TIME COSTS		$185 Million
• Milcon	$ 103 M	
• Movement	47 M	
• Personnel	6 M	
• Overhead	5 M	
• Other	2 M	
• One-Time Unique	21 M	
• NET PRESENT VALUE		$ 142 Million

AN ALTERNATIVE - *CANTONMENT*

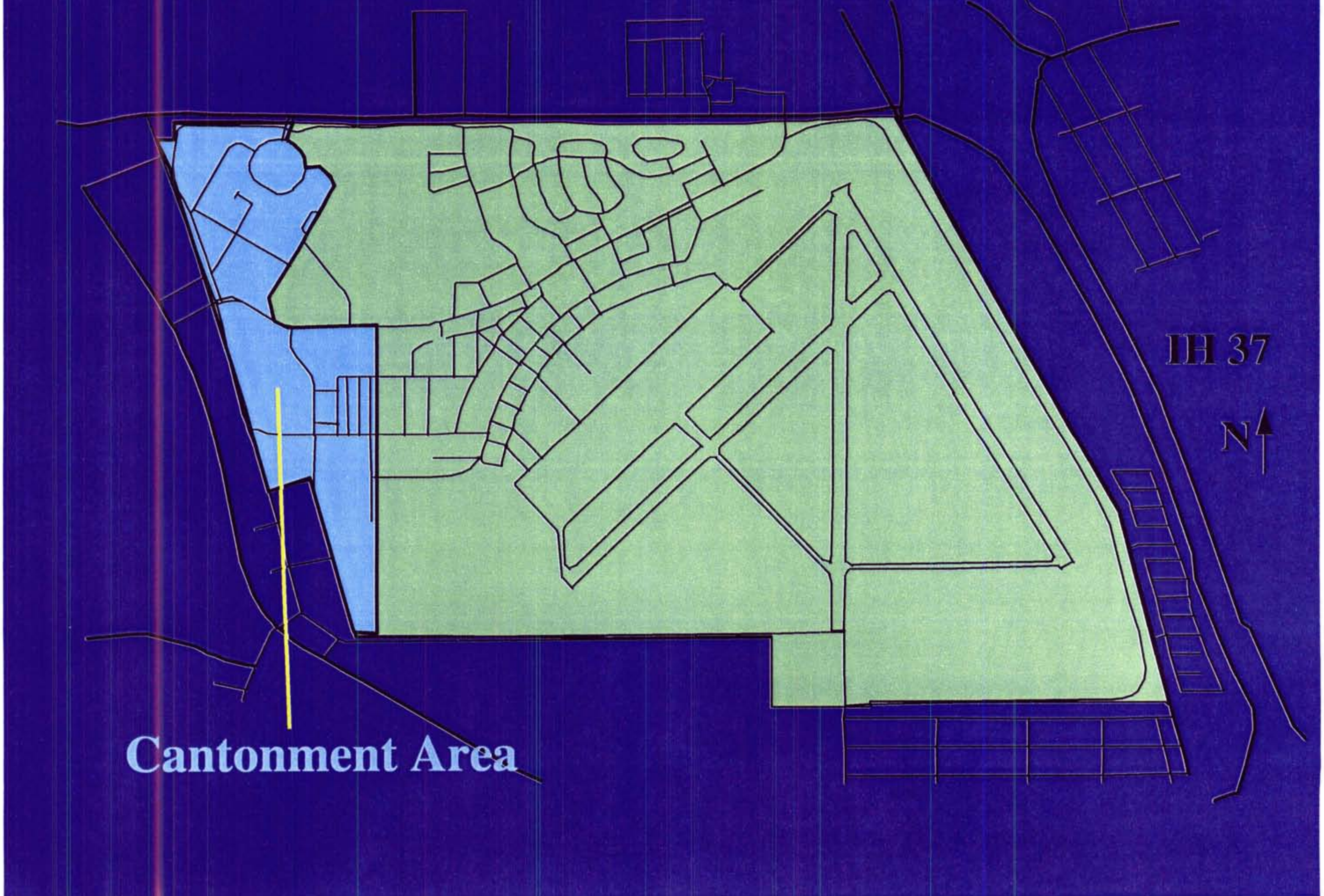
- CLOSE BROOKS AFB

- RETAIN MISSIONS IN CANTONMENT IN SAN ANTONIO
  - * Human Systems Center
  - * Human Systems Program Office
  - * Armstrong Laboratory
  - * School of Aerospace Medicine
  - * Center for Environmental Excellence

- RELOCATE TO KELLY AFB & LACKLAND AFB
  - * 68th Intelligence Squadron
  - * 710th Intelligence Squadron

- BOS & RPM PROVIDED BY KELLY AFB

BROOKS AFB



THE RESULTS

- CLOSE BROOKS AFB
- PEOPLE/JOBS
  - * Eliminate — 391
  - * Relocate — 518 (Across Town)
- ONE TIME COST — $ 11 Million
  - * MILCON $ 6 Million
- 20 YEAR NET PRESENT VALUE — $ 301 Million
- RETURN ON INVESTMENT — Immediate

COMPARISONS

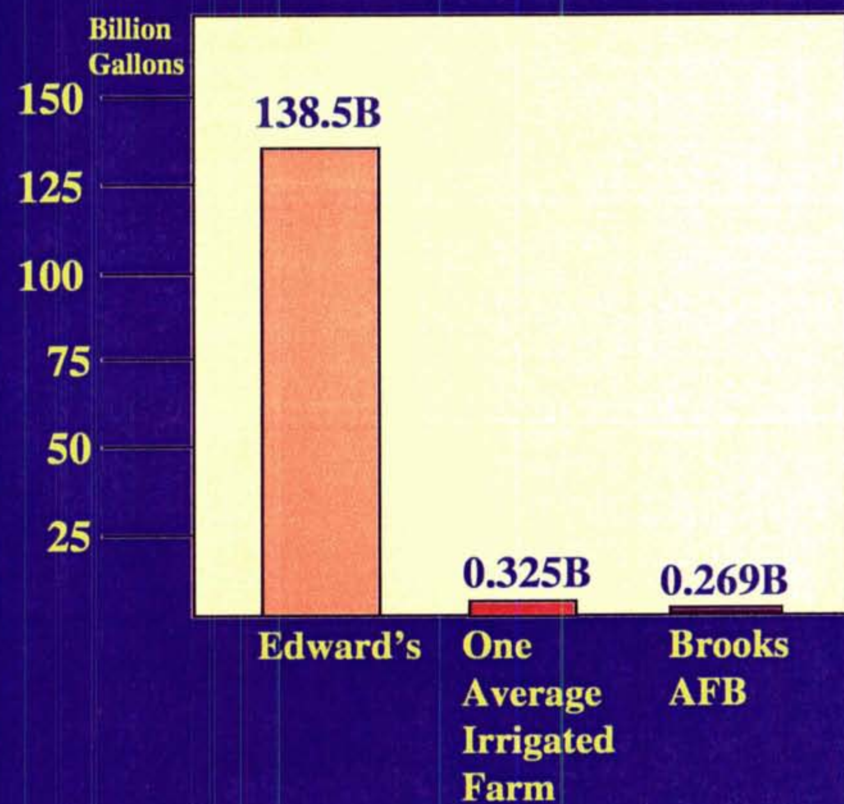
	DoD Proposal	Cantonment
• SCENARIO	RELOCATE	CANTONMENT
• BROOKS AFB	CLOSE	CLOSE
• PEOPLE		
•Eliminate	391	391
•Relocate	3,228	518
• ONE TIME COST	$ 185 Million	$ 11 Million
• 20 YEAR NET PRESENT VALUE	$ 142 Million	$ 301 Million
• RETURN ON INVESTMENT	7 Years	Immediate

BROOKS AFB

BROOKS AFB ANNUAL WATER USE

- 2/1,000 Of San Antonio Area Water Use
- 83% Of One Irrigated Farm

SAN ANTONIO ANNUAL WATER USE



CANTONMENT WOULD REDUCE BROOKS WATER USE BY 50-70%

Estimated by Tom Fox, P.E., San Antonio Water System

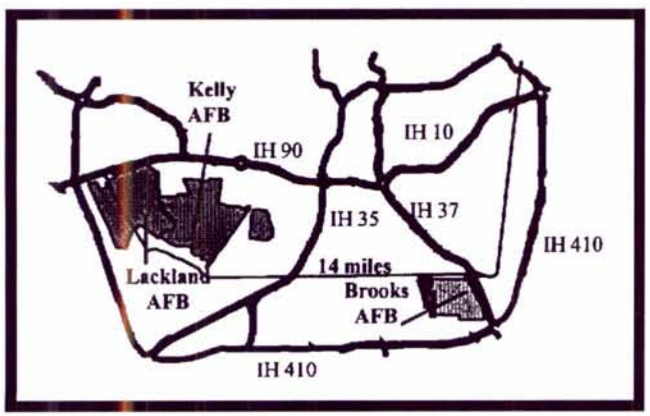
THE CASE FOR CANTONMENT

- CLOSES BROOKS AFB
- ELIMINATES 391 MANPOWER SPACES
- SAVES $ 174 Million IN ONE-TIME CLOSURE COSTS
- SAVES $ 159 Million MORE THAN DoD PROPOSAL OVER 20 YEARS
- AVOIDS RISK TO RESEARCH AND TEACHING MISSIONS
  - 2710 FEWER MOVES

Document Separator

THE CASE FOR CANTONMENT

- Closes Brooks AFB
- Eliminates 391 manpower spaces
- Saves $174 million in one time closure costs
- Saves $159 million more than DOD proposal over 20 years
- Avoids risk to research and teaching missions
- 2710 fewer moves



BROOKS AIR FORCE BASE

The Center For Human Systems Technology

BROOKS' MISSIONS ARE A NATIONAL ASSET

- **The only integrated Human Systems Research program in DoD**
  - Interdisciplinary group of physicians, social, biological, and medical scientists and engineers focused on the extension of human capabilities and enhanced performance
  - Programs cover the spectrum of research and development (Pgms 6.1-6.5) and the Defense Health Program
- **The Armstrong Laboratory is a world leader in its mission area**
  - As one of only four Air Force "super-labs," has a first class, multi-disciplinary capability with critical mass of research scientists and engineers
  - Unique facilities in excellent condition
    - Centrifuge (acceleration tolerance/protection)
    - Hyperbaric Chambers
    - Spatial Disorientation Demonstrator (one of only three in the world)
    - Directed Energy Chambers (radio frequency radiation exposure)
    - *The* Air Force Drug Testing Laboratory
  - Unique interaction with Air Education and Training Command in training concepts and technologies
  - A leader in implementing tri-service programs and co-locations (e.g. Directed Energy Bioeffects program)
  - Unlimited opportunity to absorb additional DoD human research missions and to become a DoD center of Excellence for human systems technology
  - $6.75M directed energy facility under contract for construction (FY'95)
- **USAF School of Aerospace Medicine**
  - The nation's leading aerospace medical training program
  - Internationally known and respected
  - The Armstrong Laboratory provides 30% of the facility
    A proven vehicle for transitioning the latest medical knowledge from the research lab to USAF operational aerospace flight surgeons, nurses, and technicians
  - $7.2M facility under construction (FY '94)
- **Air Force Center for Environmental Excellence**
  - Absolutely essential to long term Air Force environmental programs in the areas of compliance, hazardous waste cleanup, and environmental planning
  - $7.5M facility under construction (FY '94)

SAN ANTONIO PROVIDES A UNIQUE SYNERGY

- One of a kind configuration of biomedical teaching and research activities
- Significant capability multiplier
  - Interaction and cross fertilization
  - Joint projects

	D.O.D PROPOSAL	CANTONMENT ALTERNATIVE
SCENARIO	Close Brooks; Move Missions to Wright Patterson and Tyndall	Close Brooks; Keep Missions in cantonment; BOS by Kelly
BROOKS AFB	CLOSE	CLOSE
PEOPLE		
• Eliminate	391	391
• Move	3228	518 (local)
1X COST	$185 m	$11 m
20 YR NPV	$142 m	$301 m
ROI	7 years	Immediate

ARMSTRONG LABORATORY

FACILITY AND EQUIPMENT OVERVIEW

6 APRIL 1995

AGENDA

- REQUIREMENT
- COST DATA FOR LABORATORY CONSTRUCTION AND MOVES
- ESTIMATE COMPARISON
- EQUIPMENT AND FACILITY ISSUES

REQUIREMENT

- CLOSE BROOKS AFB
- MOVE HSC, SAM, AND AL TO WP-AFB
- HYPERBARIC CHAMBERS RELOCATE TO LACKLAND AFB TX

ARMSTRONG LABORATORY
BROOKS AFB TX

- 1181 SCIENTISTS, ENGINEERS, AND SUPPORT
- $75M RESEARCH EQUIPMENT AND COMPUTERS: ORIGINAL COST
- 8.5M POUNDS OF EQUIPMENT, LIBRARY, AND FURNITURE
- UNIQUE FACILITY REQUIREMENTS
- 289 CONTRACT SCIENTISTS, ENGINEERS, AND SUPPORT

COMPARATIVE LABORATORY FACILITY DATA

WALTER REED ARMY INSTITUTE OF RESEARCH (WRAIR)

- REQUIREMENTS SIMILAR TO ARMSTRONG LABORATORY
- A&E DESIGN ESTIMATE FOR A MEDICAL RESEARCH FACILITY
  - 1036 RESEARCHERS AND SUPPORT
  - 460,000 SQUARE FEET
  - FACILITY COST: $147.3M
  - $320/SF = $142K/PERSON
- MOST ACCURATE COST DATA AVAILABLE FOR THE TYPE OF FACILITY THAT ARMSTRONG LAB REQUIRES

COMPARATIVE LABORATORY FACILITY DATA (con't)

KELLY MILCON ESTIMATE

- 1994 AFMC 21 ESTIMATE TO REBUILD AL AT KELLY
- NOT BASED ON A&E DESIGN ESTIMATE
  - $312M TO INCLUDE DORMS, HOUSING, VOQ
  - $255M FOR R&D FACILITY
  - 1,087,000 SF R&D FACILITY
  - $235/SF

THE AUSTIN COMPANY
COMPLETED FACILITY COST SUMMARY

	Total Building Area (SF)	Laboratory Area (SF)	Office & Admin. Area (SF)	Total Project Cost (x $1,000)	$ Per SF (1994 Dollars)
Mobil Oil Beaumont, Tx.	19,850	12,685	7,165	$ 4,320	$ 217.63
Diamond Shamrock Three Rivers, Tx.	10,550	7,492	3,058	$ 2,746	$ 260.25
Citgo Lake Charles, La.	27,636	10,936	16,700	$ 5,382	$ 194.75
Exxon (Remodel) Baton Rouge, La.	5,953	4,559	1,394	$ 1,224	$ 211.78
Mobil Chem. Houston, Tx.	5,832	4,082	1,750	$ 1,850	$ 317.00
Chevron Belle Chasse, La.	12,094	7,620	4,474	$ 2,600	$ 214.98
Rexene Odessa, Tx.	4,262	2,314	1,948	$ 1,154	$ 270.76
Hoechst Celanese Bayport, Tx.	11,100	9,950	1,150	$ 3,771	$ 339.73
Average	12,160			$ 2,881	$ 236.92

Phibro USA
Phibro Energy USA, Inc.

THE AUSTIN COMPANY
ARCHITECTS ENGINEERS BUILDERS

LABORATORY FACILITY COST ESTIMATE COMPARISON

	COST/SF	AL SPACE REQUIREMENT (SF)	COST
WRAIR LABORATORY	$320	580,000	$ 185,600,000
AUSTIN CO. AVG.	$237	580,000	$ 137,460,000
KELLY AFB MILCON	$235	580,000	$ 136,300,000
COBRA MODEL	$136	580,000	$ 78,880,000

LABORATORY EQUIPMENT AND FACILITY ISSUE HIGHLIGHTS

HUMAN/ANIMAL CENTRIFUGE
RESEARCH ENVIRONMENTAL CHAMBERS
AEROMEDICAL EQUIPMENT AIRWORTHINESS CERTIFICATION FACILITY
HIGH ALTITUDE RESEARCH SUPPORT FACILITY
DISPOSITION OF LEGACY ANIMALS
CAPACITY OF WPAFB ANIMAL FACILITIES
ANALYTICAL/RADIOANALYTICAL CAPABILITY
RELOCATION OF LASER AND BIOEFFECTS
SECURITY SPACE REQUIREMENTS
RELOCATION OF REFERENCE LABORATORY
RELOCATION OF HYPERBARIC SERVICES
RELOCATION OF ANECHOIC CHAMBERS

CATEGORY III ITEM #CFT-01
HUMAN/ANIMAL CENTRIFUGE

- **ISSUE:** RELOCATION OF THE BROOKS AFB HUMAN/ANIMAL CENTRIFUGE TO W-P AFB

- **FACTS:**
  - MOST ACTIVE AND PRODUCTIVE CENTRIFUGE IN WORLD
  - MAXIMUM **30 G** TEST CAPABILTIY
  - ONLY CENTRIFUGE THAT CAN MATCH FIGHTER CAPABILITY
    - **9 G; 6 G/SEC ONSET RATE**
  - LOW O&M COSTS COMPARED TO OTHER CENTRIFUGES
  - NAVY CLOSING DOWN WARMINSTER CENTRIFUGE

- **RECOMMENDATIONS:** MOVE THE BROOKS AFB CENTRIFUGE INTO A NEW BUILDING AT WPAFB.

- **IMPACT IF NOT RESOLVED:** LOSS OF A UNIQUE NATIONAL ASSET

CATEGORY III ITEMS #CFT-07, 08, 09

RESEARCH ENVIRONMENTAL CHAMBERS
AEROMEDICAL EQUIPMENT AIRWORTHINESS CERTIFICATION FACILITY
HIGH ALTITUDE RESEARCH SUPPORT FACILITY

- **ISSUE:** RESEARCH ALTITUDE CHAMBERS/SUPPORT EQUIPMENT, RELOCATE TO WPAFB

- **FACTS:**

  - 7 SPECIALIZED RESEARCH ALTITUDE AND ONE ENVIRONMENTAL CHAMBERS

  - REQUIRES REMOVAL OF BUILDING WALLS AND SPECIAL EXTRACTION EQUIPMENT

  - 19 HIGH CAPACITY VACUUM PUMPS, THERMAL CONDITIONING SYSTEM (SLED MOUNTED TANKS, PUMPS AND COMPRESSORS, AND HOT GLYCOL CIRCULATION SYSTEM)

- **RECOMMENDATION:**

  - DESIGN/BUILD NEW FACILITY TO ACCOMMODATE RESEARCH/ENVIRONMENTAL CHAMBERS AT W-P AFB

CATEGORY III ITEMS #CFT 07, 08, 09

RESEARCH ENVIRONMENTAL CHAMBERS
AEROMEDICAL EQUIPMENT AIRWORTHINESS CERTIFICATION FACILITY
HIGH ALTITUDE RESEARCH SUPPORT FACILITY

- **IMPACT IF NOT RESOLVED**

  - ONLY AEROSPACE ALTITUDE RESEARCH FACILITY IN DOD

  - LOSS WOULD ELIMINATE:
    - SUPPORT TO ACC, USSOCOM, AND NASA
    - ON BOARD OXYGEN GENERATING SYSTEMS DEVELOPMENT
    - LIFE SUPPORT EQUIPMENT DEVELOPMENT AND MAN-RATING
    - AIRWORTHINESS CERTIFICATION OF AEROMEDICAL EVACUATION EQUIPMENT
    - RESEARCH ON SPECIALIZED REQUIREMENTS FOR HIGH ALTITUDE PROTECTION

  - 1 - 1.5 YEARS DOWN TIME

CATEGORY III ITEM #OE-1
DISPOSITION OF LEGACY ANIMALS

- **ISSUE:** LEGACY ANIMALS REQUIRE LIFETIME CARE
- **FACTS:**
  - MOVE TO WPAFB NOT NEEDED
  - NO FURTHER RESEARCH, JUST SUPPORT
  - AAALAC CARE REQUIRED, SOMEWHERE
- **RECOMMENDATION:**
  - MILCON SPACE AT WPAFB
  - MOVE COLONY TO NEW LOCATION
  - LEASE BROOKS FACILITIES
- **IMPACT IF NOT RESOLVED:** CARE IS REQUIRED FOR 10-15 YEARS

CATEGORY III ITEM #OE-2
CAPACITY OF WPAFB ANIMAL FACILITIES

- **ISSUE:** SHORT FALL IN ANIMAL FACILITIES AT WPAFB EXISTS
- **FACTS:**
  - SPACE REQUIRED BEFORE MOVE OF ANIMALS
  - BAFB HAS 100K SF SPACE, WPAFB HAS 50K SF
  - SHORTFALL OF 60K SF IF CONSOLIDATE
  - SPACE IS EXPENSIVE
- **RECOMMENDATION:** LEASE OR BUILD SPACE AT WPAFB
- **IMPACT IF NOT RESOLVED:** LOSS OF ANIMAL SUPPORT SHUTS DOWN IN-HOUSE BIOEFFECTS WORK

CATEGORY III ITEM #OE-6
ANALYTICAL/RADIOANALYTICAL

- **ISSUE:** ENGINEERING SERVICE MISSION REQUIRES LABORATORY, COLLOCATION WITH CONSULTANTS
- **FACTS:** 60K SF LAB, 14K SF ADMIN, 3K SF HAZMAT
  MEDIUM LABS WITH HVAC (58 HOODS NOW)
  PROVIDE 30% OF AF ESOH ANALYSES, 90K PLUS
  COLLOCATED FOR READINESS MISSION
  EQUIPMENT REQUIRES R/R BY VENDOR
  RECERTIFICATION REQUIRED FOR WPAFB
- **RECOMMENDATION:** MOVE AS UNIT TO WPAFB
- **IMPACT IF NOT RESOLVED:** READINESS MISSION IMPACT. LOSS OF ESOH ANALYTICAL CAPABILITY

CATEGORY III ITEM #OE-7
RELOCATION OF LASER AND RFR BIOEFFECTS

- **ISSUE:** RELOCATION OF RF AND LASER BIOEFFECTS INVOLVES TRISERVICE RELIANCE COLLOCATES
- **FACTS:**
  - AGREEMENTS MAKE USAF RESPONSIBLE FOR MOVE
  - COLLOCATION DEMONSTRATED AS EFFECTIVE
  - 35 XMITERS, 9 CHAMBERS
  - 14 LASERS, 15 OPTICAL BENCHES
  - ALL COLLOCATES NEED ANIMAL MODEL SUPPORT
- **RECOMMENDATION:** STUDY ALL OPTIONS FOR MOVE
- **IMPACT IF NOT RESOLVED:** LOSE BIOEFFECTS R&D

CATEGORY III ITEM #OE-12
SECURITY SPACE REQUIREMENTS

- **ISSUE:** SECURE SPACE FOR MATH PRODUCTS DIVISION
- **FACTS:**
  - 3.4K SF SCIF, 3K NET ADMIN
  - COMPUTER WORKSTATIONS REQUIRE MOVE
  - READY SPACE NEEDED TO FACILITATE, IF MOVED
  - PROVIDES ONLY 1/3 SPACE FOR RELIANCE DETACHMENTS
- **RECOMMENDATION:** LEASE OR BUILD SPACE AT WPAFB
- **IMPACT IF NOT RESOLVED:** DELAYS IN IMPORTANT CLASSIFIED R&D

CATEGORY III ITEM #AO-01
RELOCATION OF REFERENCE LABORATORY

- **ISSUE:** DISRUPTION OF WORLD-WIDE REFERENCE LABORATORY SERVICES PROVIDED BY THE EPIDEMIOLOGIC RESEARCH DIVISION (AOE)

- **FACTS:**
  - RECERTIFICATION REQUIRED
  - 1 YEAR MINIMUM TIME BEFORE CERTIFICATION

- **RECOMMENDATION:** PROVIDE INTERIM CONTRACT SERVICES

- **IMPACT IF NOT RESOLVED:** LOSS OF PATHOGEN SCREENING REQUIRED FOR DEPARTMENT OF DEFENSE MEDICAL TREATMENT FACILITIES.

CATEGORY III ITEM #AO-04
RELOCATION OF HYPERBARIC SERVICES

- **ISSUE:** MAJOR ENGINEERING EFFORT REQUIRED TO RELOCATE HYPERBARIC SERVICES. EXISTING CHAMBERS ARE IN EXCESS OF 30 YEARS OLD.
- **FACTS:**
  - NEW SUPPORT FACILITIES MUST MEET NEW NATIONAL FIRE PREVENTION ASSN (NFPN)
  - PRESSURE VESSELS MUST MEET HUMAN OCCUPANCY (PUHO) STANDARDS.
- **RECOMMENDATION:**
  - RELOCATE EXISTING CHAMBERS IN NEW SUPPORT FACILITY
- **IMPACT IF NOT RESOLVED:** LACK OF TREATMENT CAPABILITY

CATEGORY III ITEM #AO-05
RELOCATION OF ANECHOIC CHAMBER

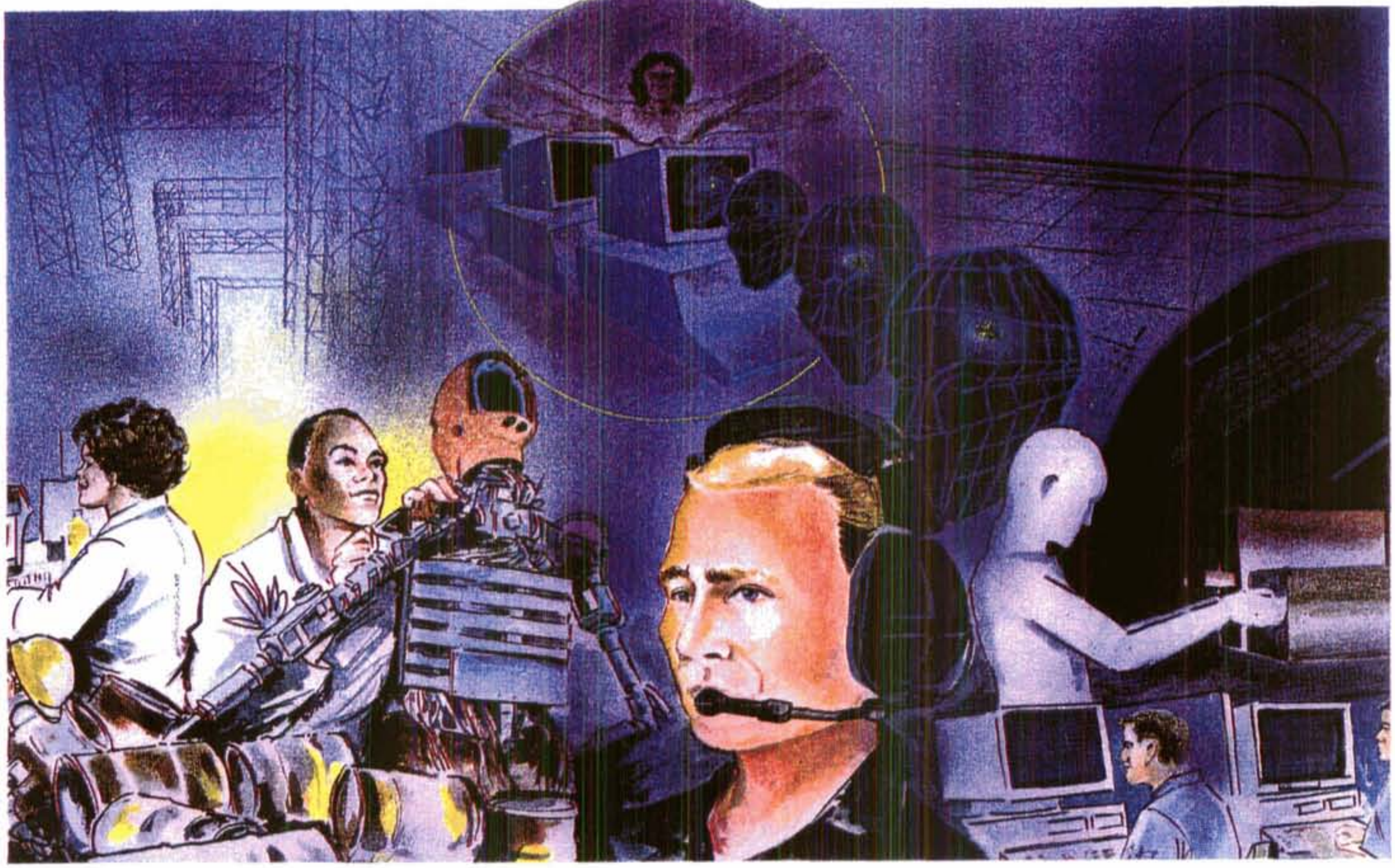
- **ISSUE:** RELOCATION OF ANECHOIC CHAMBER
- **FACTS:**
  - CHAMBERS ARE CUSTOM MADE
  - CONSTRUCTED INTO BUILDING
- **RECOMMENDATION:** BUILD ANECHOIC CHAMBER AT WPAFB
- **IMPACT IF NOT RESOLVED:** AIRCREWS CANNOT BE TESTED FOR RESEARCH IN HUMAN SYSTEMS PROGRAMS.

Document Separator

ARMSTRONG LABORATORY

MEETING THE HUMAN CHALLENGE
GLOBAL POWER - GLOBAL REACH

ARMSTRONG LABORATORY



Human-Centered Technologies Now Available for Licensing, as a Service, or under Collaborative Research Programs

Some Examples

- ✔ Crash Impact Protection Devices
- ✔ Gene Probes
- ✔ Computer-aided Human-Machine Interfaces
- ✔ Interactive Computer Tutoring Programs
- ✔ Auditory Displays
- ✔ Virtual Environments
- ✔ Logistics Management
- ✔ Laser Eye Protection

Tap into these and other technologies developed by Armstrong Lab's 700 scientists and engineers

Call, mail or fax your request

Office of Research and
Technology Applications (ORTA)
Mr. Douglas Blair or Major Bruce Pollock
AL/XPTT
2509 Kennedy Circle
Brooks Air Force Base
TX 78235-5118
210-536-3817 • FAX 210-536-2810

- ❒ Human Engineering
- ❒ Computer-Based Training
- ❒ Simulation/Synthethic Environments
- ❒ Personal Protective Devices
- ❒ Man-Machine Interface
- ❒ Dental Equipment/Materials Testing
- ❒ Selection & Classification Systems - Personnel
- ❒ Directed Energy Bioeffects
- ❒ Environmental Toxicology
- ❒ Health Risk Assessment
- ❒ Drug Testing
- ❒ Selection/Retention Standards - Medical

Name________ Title________

Company________ Office Phone________

Address________ Fax#________

City________ State____ Zip Code________

CALL OUR ORTA OFFICE AND FIND THE RIGHT PERSON IN ARMSTRONG LAB TO HELP YOU

ARMSTRONG LABORATORY

OVERVIEW

HUMAN-CENTERED SCIENCE & TECHNOLOGY

Dr Brendan Godfrey
Director

ARMSTRONG LABORATORY

ARMSTRONG LABORATORY

provides integrated, interdisciplinary technologies to enhance human military performance while protecting people and the environment.

Personnel assigned: 1539
FY95 budget: $196M

ARMSTRONG LABORATORY

AL PROVIDES BROAD RANGE OF HUMAN-CENTERED RESEARCH AND SERVICES

Research and Development (MFP6)

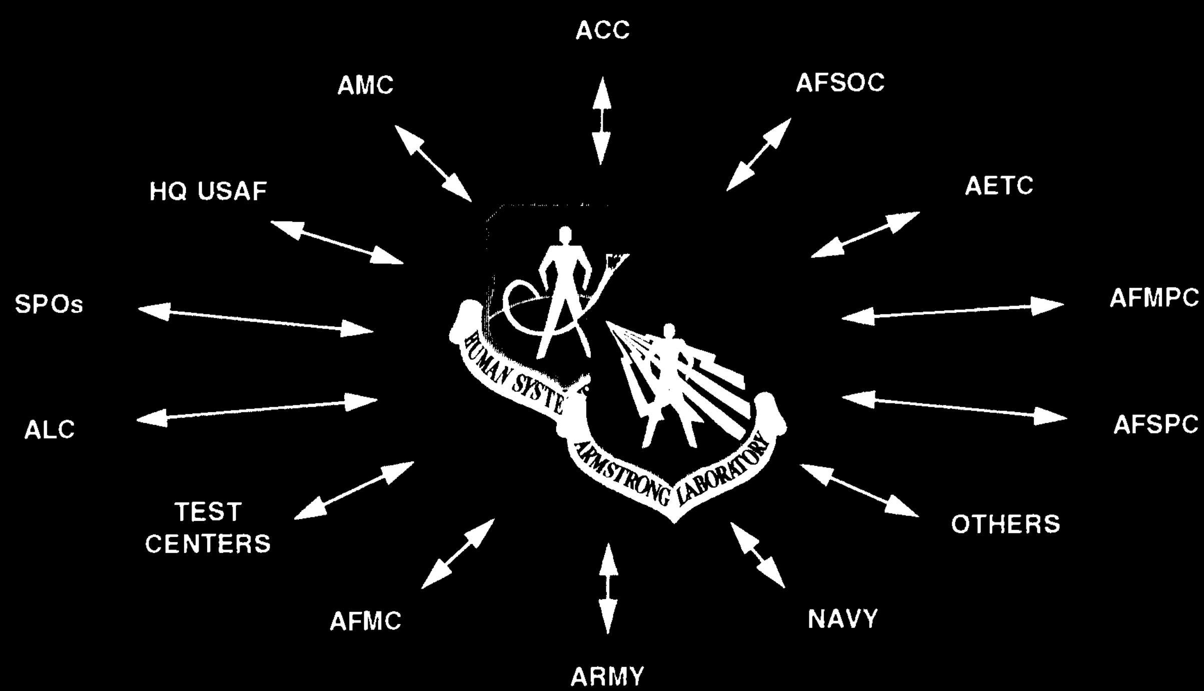
- Aircrew Performance and Protection
- Enhanced Aircrew Selection & Retention
- Manpower, Personnel, Training and Logistics
- Directed Energy Bioeffects
- Environmental Compliance and Remediation
- Occupational and Environmental Toxicology

Defense Health Program (MFP7/8)

- Preventive & Health Services Assessment
- Occupational & Environmental Health Services
- Drug Testing and Epidemiological Reference Labs
- Hyperbaric Medicine

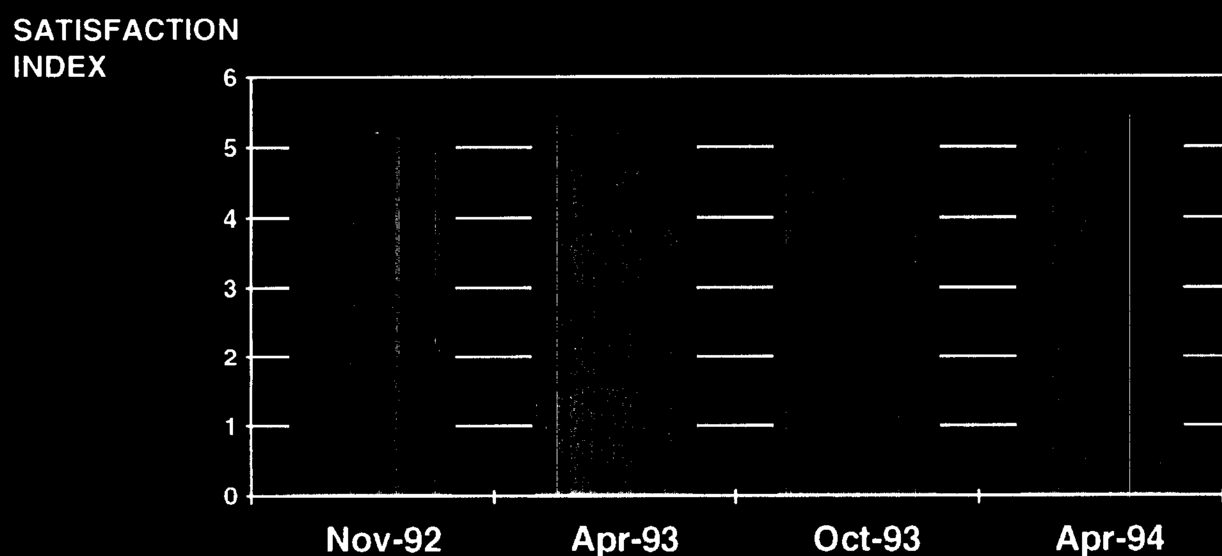
ARMSTRONG LABORATORY

AL R&D MEETS PERVASIVE NEEDS OF AIR FORCE AND OTHERS



ARMSTRONG LABORATORY

REGULAR SURVEYS SHOW STRONG CUSTOMER SATISFACTION



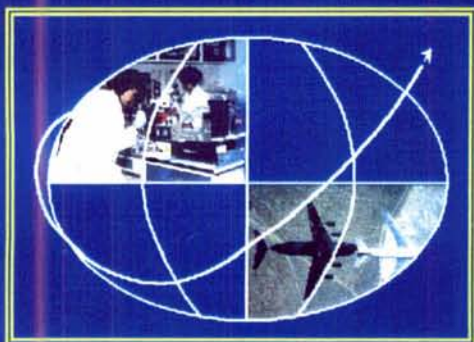
RESPONSES

NOV 92 = 68	OCT 93 = 192
APR 93 = 175	APR 94 = 174

ARMSTRONG LABORATORY

AL TECHNOLOGIES ENHANCE WARFIGHTING CAPABILITIES

Spatial Disorientation



Sustained Performance

Laser Eye Protection

Next Generation Escape System

ARMSTRONG LABORATORY

AL TECHNOLOGIES SAVE DEFENSE DOLLARS

Integrated Maintenance Information System

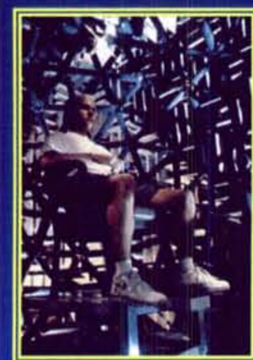
Advanced Hybrid Oxygen System

Aircrew Standards Research

Bioventing

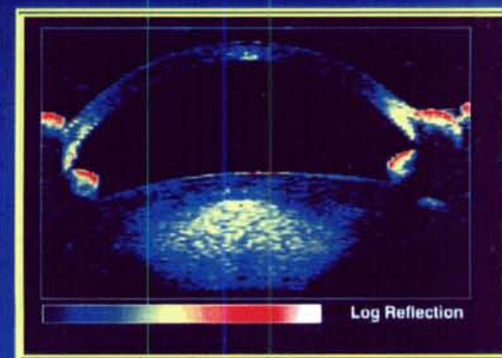
ARMSTRONG LABORATORY

AL TECHNOLOGY ENHANCES U.S. ECONOMIC COMPETITIVENESS



3-D Audio

Fundamental Skills Tutor



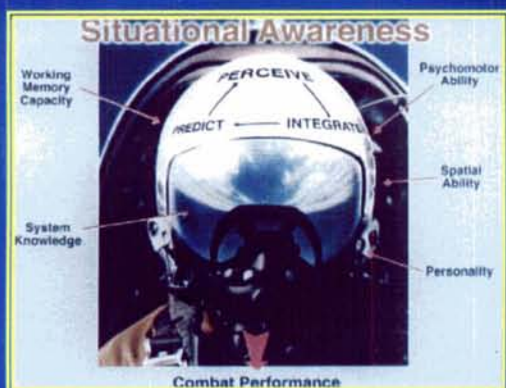
Optical Coherence Tomography

Electroless Nickel Plating

ARMSTRONG LABORATORY

AL UNIQUE INTERDISCIPLINARY CAPABILITIES CRITICAL TO MANY ACCOMPLISHMENTS

Advanced High-G Protection
- Human Physiology
- Suit Design
- Cockpit Compatibility
- Training
- Crew Selection



Situational Awareness
- Display Design
- Control Technology
- Performance Measurement
- Training
- Crew Selection

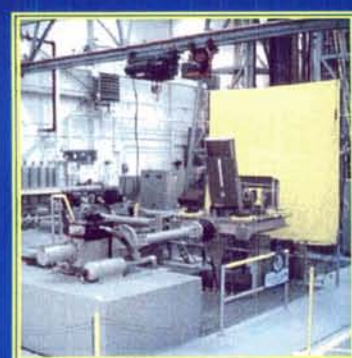
ARMSTRONG LABORATORY

RELIANCE LEADERSHIP ENHANCES AL PERFORMANCE

Toxicology

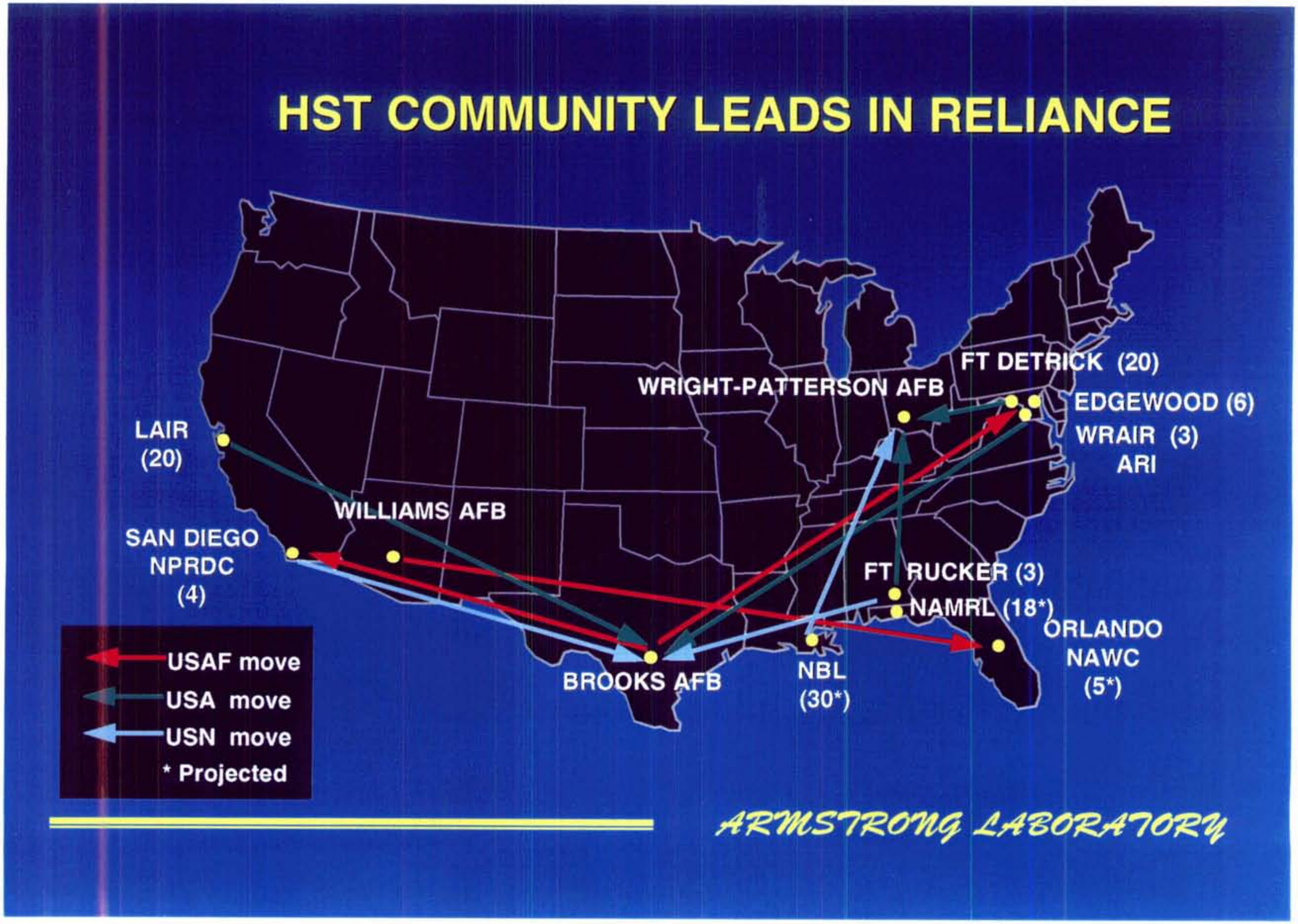
Chem-Bio

Directed Energy Bioeffects



Biodynamics

ARMSTRONG LABORATORY


HST COMMUNITY LEADS IN RELIANCE
FT DETRICK (20)
WRIGHT-PATTERSON AFB
EDGEWOOD (6)
WRAIR (3)
ARI
LAIR
(20)
WILLIAMS AFB
SAN DIEGO
NPRDC
(4)
FT RUCKER (3)
NAMRL (18*)
ORLANDO
NAWC
(5*)
BROOKS AFB
NBL
(30*)
USAF move
USA move
USN move
* Projected
ARMSTRONG LABORATORY

AL TIGHTLY INTEGRATED WITH SAN ANTONIO MILITARY COMMUNITY

USAF School of Aerospace Medicine (SAM)
- *Joint projects and personnel exchanges*

Air Force Center for Environmental Excellence (AFCEE)
- *Recipient and broker of AL environmental technologies*

Human Systems Program Office
- *Transition human-centered technology*

Air Education and Training Command (AETC)
- *Requirements, evaluations and subjects for aircrew training R&D*

Air Force Military Personnel Center
- *Repository for MPC database*

Lackland AFB
- *Facilities and subjects for training and selection research*

Kelly AFB
- *Bioremediation Test Site*

ARMSTRONG LABORATORY

AL TIGHTLY INTEGRATED WITH DAYTON MILITARY COMMUNITY

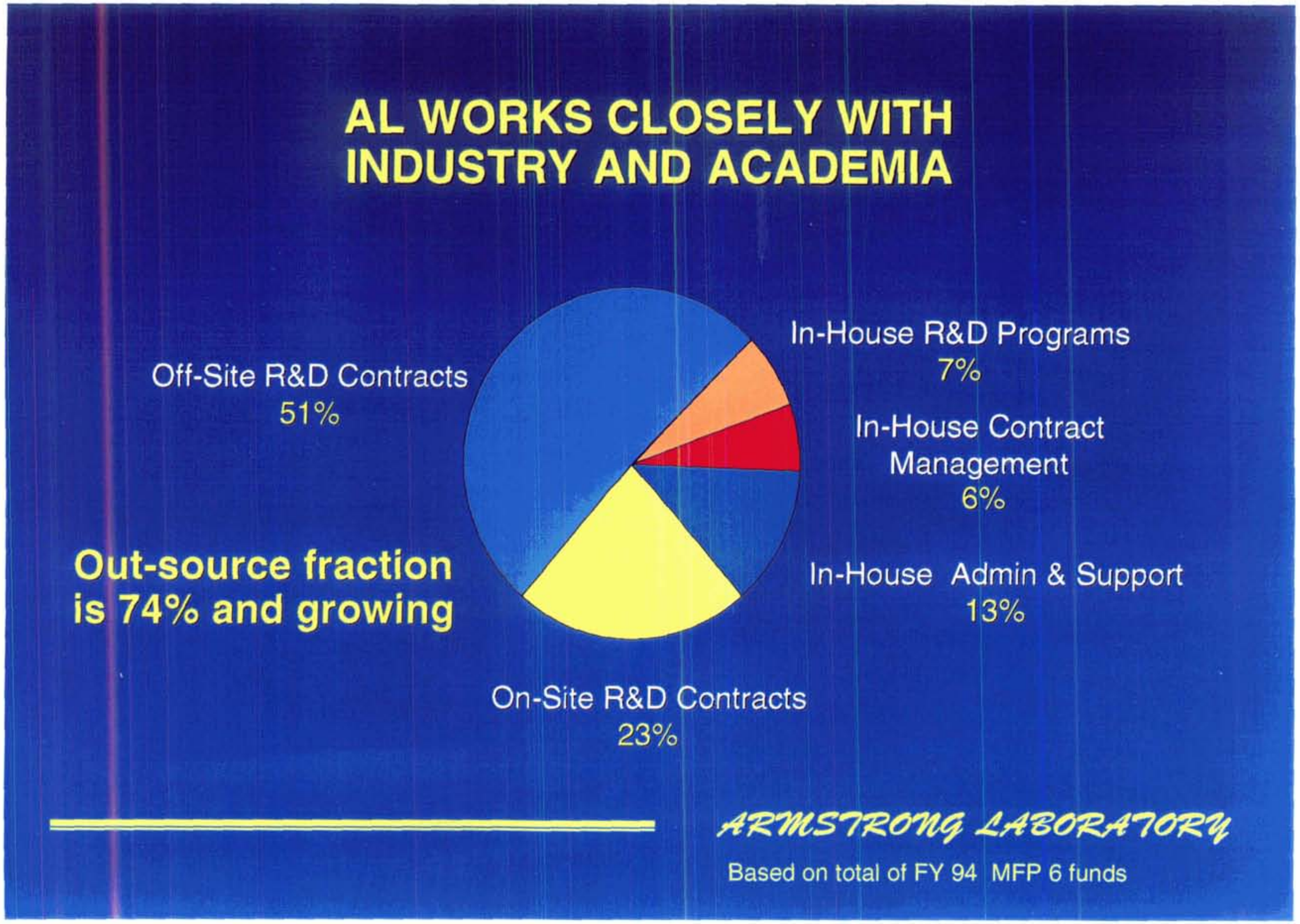
- Wright Laboratory
  - *Sensor/Windscreen Development*
  - *Laser Eye Protection*
  - *Environmentally Conscious Manufacturing*
- Aircraft SPOs
  - *IMIS Transition*
  - *Anthropometry*
  - *Helmet-Mounted Display*
- Joint Cockpit Office
  - *Joint Advanced Strike Technology (JAST)*
  - *Advanced Life Support*
- HQ AFMC
  - *Logistics Support Requirements*
  - *Technology Transfer*

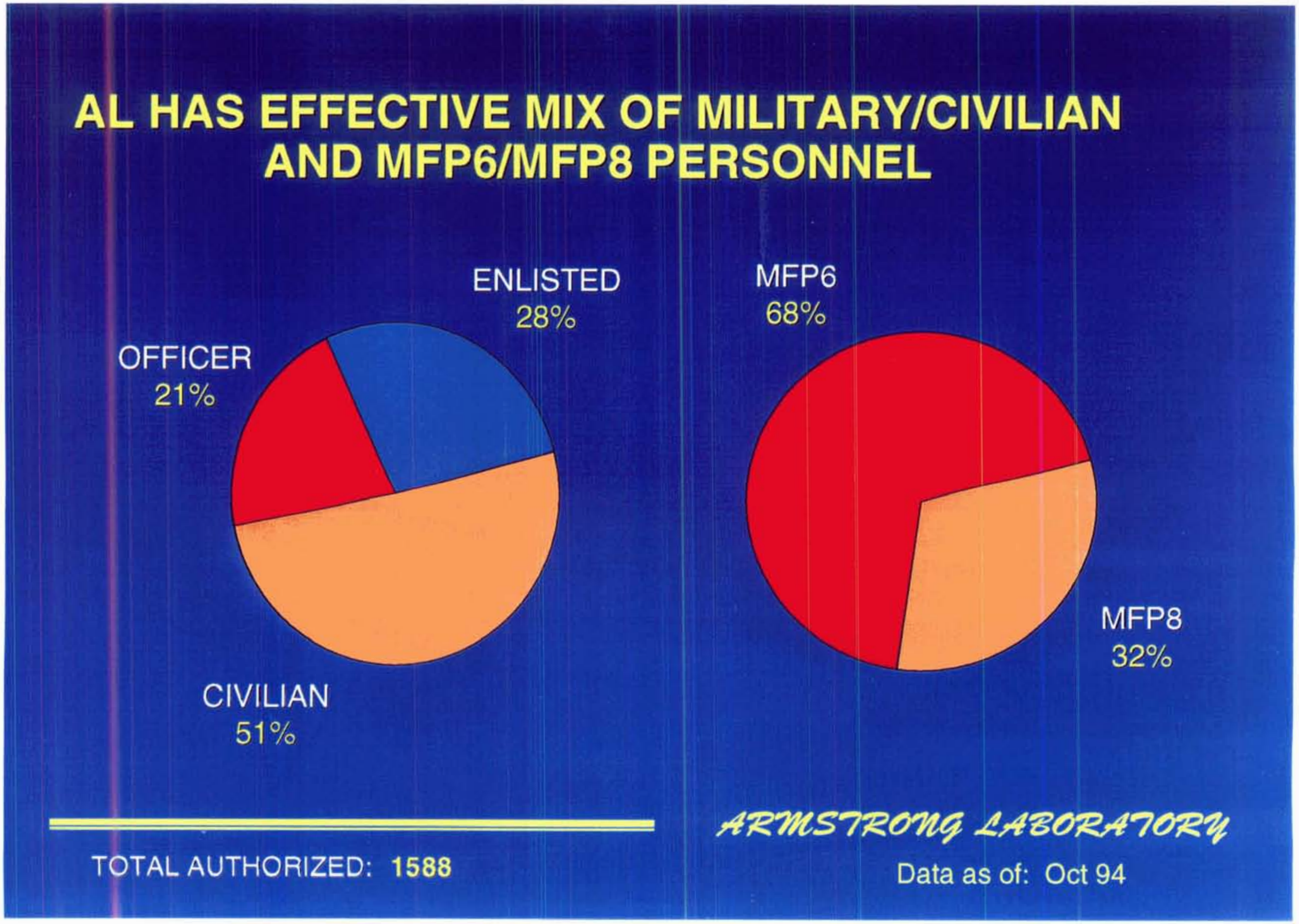
ARMSTRONG LABORATORY

AL TIGHTLY INTEGRATED WITH CIVILIAN COMMUNITY

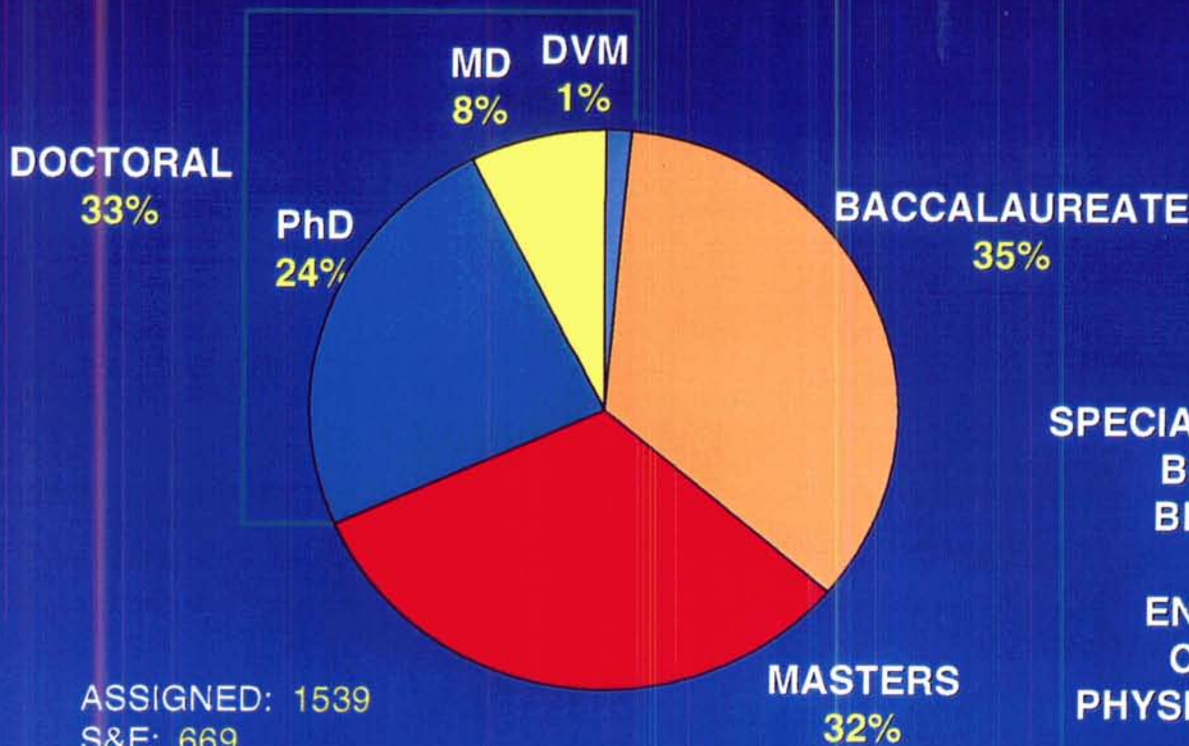
- Collaborations and Faculty Appointments
  - University of Texas Health Science Center
  - Southwest Research Institute
  - University of Texas-San Antonio
  - St Mary's University
  - Wright State University
  - Ohio University
- Linkage to Community Economic Development
  - Texas Research Park
  - San Antonio 2000
  - Forum Entrepreneur

ARMSTRONG LABORATORY


AL WORKS CLOSELY WITH
INDUSTRY AND ACADEMIA
Off-Site R&D Contracts
51%
In-House R&D Programs
7%
In-House Contract
Management
6%
Out-source fraction
is 74% and growing
In-House Admin & Support
13%
On-Site R&D Contracts
23%
ARMSTRONG LABORATORY
Based on total of FY 94 MFP 6 funds


AL HAS EFFECTIVE MIX OF MILITARY/CIVILIAN
AND MFP6/MFP8 PERSONNEL
ENLISTED
28%
OFFICER
21%
CIVILIAN
51%
MFP6
68%
MFP8
32%
TOTAL AUTHORIZED: 1588
ARMSTRONG LABORATORY
Data as of: Oct 94

OUTSTANDING MIX OF DISCIPLINES AND DEGREE LEVELS



ASSIGNED: 1539
S&E: 669

SPECIALITIES INCLUDE:
BIOLOGICAL
BEHAVIORAL
MEDICAL
ENGINEERING
COMPUTER
PHYSICAL SCIENCES

ARMSTRONG LABORATORY

Data as of: Oct 94

AL RECOGNIZED FOR TECHNICAL EXCELLENCE

Major Awards	13
Fellows (New)	10
Other Professional & Community Recognitions	35
Professional Society Officers	74
University Adjunct Faculty Appointments	52
Refereed Journal Articles & Book Chapters	164
Other Reports & Presentations	639
Patent & Invention Disclosures	27
Cooperative R&D Agreements	28

ARMSTRONG LABORATORY

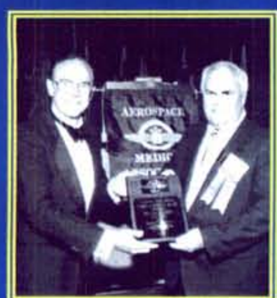
Totals for FY94

SEVERAL FY94 MAJOR AWARD WINNERS

Excellence in Military
Medicine - LtCol Paul Morton

Harold Brown Award
Col Ronald Hill

AF Basic Research Award
Dr Johnathan Kiel



AsMA H. G. Moseley Award
Dr William Albery

R&D 100 AWARD
Lt Phillip Brown

IEEE Distinguished MemberAward
Dr Daniel Repperger

ARMSTRONG LABORATORY

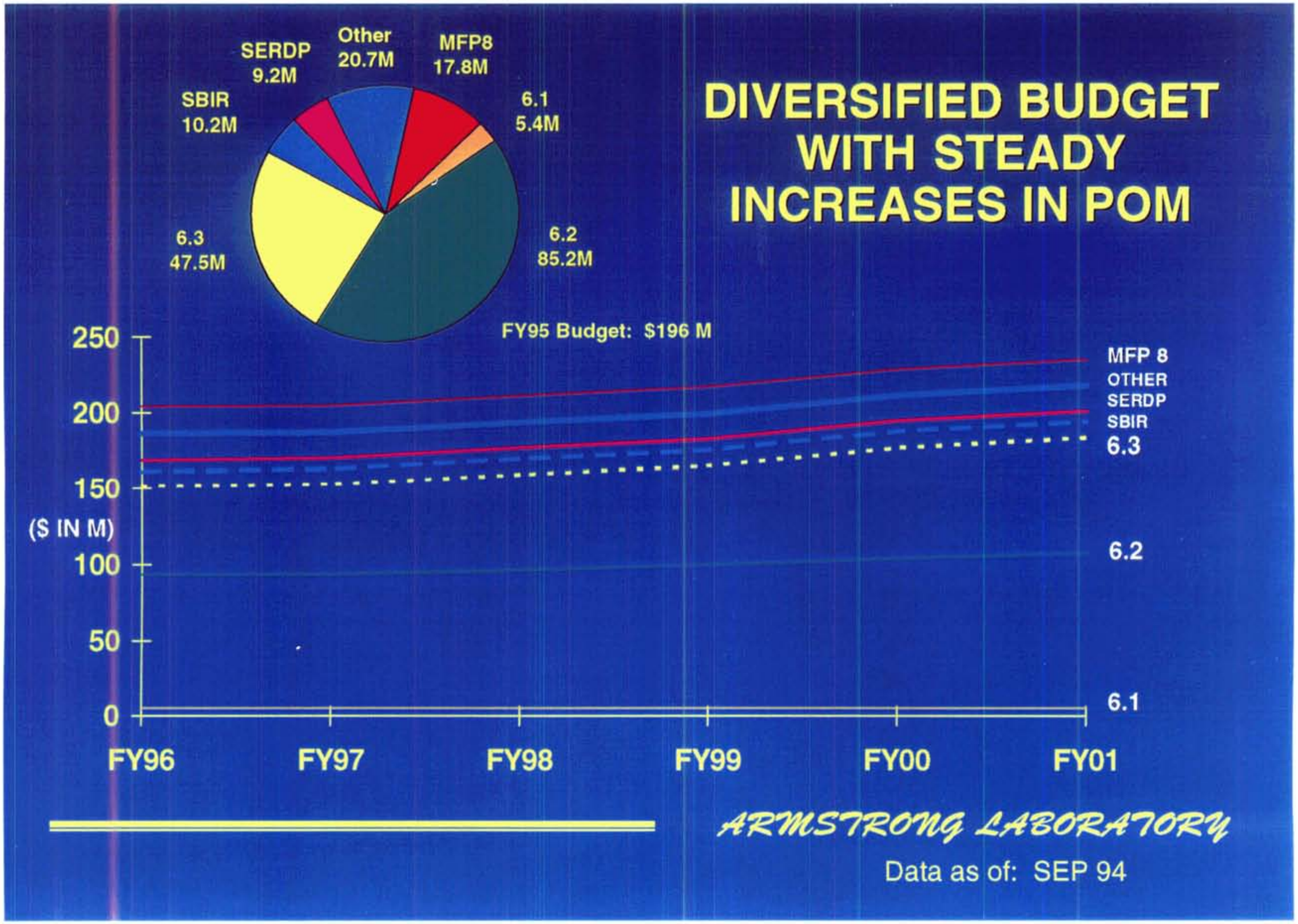
NUMEROUS MODERN FACILITIES

Virtual Environments Research Facility
Simulator Laboratory (Tempest)
Full Field of View Dome Display
Human-Centered Design Research Facility
Hyperbarics Facilities
Drug Testing Laboratory
High Speed Centrifuges
Advanced Spatial Disorientation Device
Biocommunications Laboratory
Acceleration/Impact Facilities
Environmental/Occupational Toxicology Facilities
Directed Energy Bioeffects Facilities
Propellants Disposal Pilot Plant
Bioremediation Laboratory
Accredited Vivariums

Centrifuge

Multi-Rad

ARMSTRONG LABORATORY


DIVERSIFIED BUDGET WITH STEADY INCREASES IN POM
SERDP 9.2M
Other 20.7M
MFP8 17.8M
SBIR 10.2M
6.1 5.4M
6.3 47.5M
6.2 85.2M
FY95 Budget: $196 M
250
200
150
($ IN M)
100
50
0
MFP 8
OTHER
SERDP
SBIR
6.3
6.2
6.1
FY96
FY97
FY98
FY99
FY00
FY01
ARMSTRONG LABORATORY
Data as of: SEP 94

TOMORROW'S AIR FORCE
Today

DEDICATED TO:

SELECTING
PROTECTING
INTEGRATING
MAINTAINING

***PEOPLE** IN AIR FORCE SYSTEMS AND OPERATIONS*

ARMSTRONG LABORATORY

Point Paper
on
HSC Projects Supported By
Defense Health Program (DHP) Funding

In FY95 Human Systems Center received DHP funding to support programs at the Armstrong Laboratory, USAF School of Aerospace Medicine, 70th Medical Squadron, and the Human Systems Program Office

- Armstrong Laboratory received DHP funds to support the following programs
  -- Epidemiology Laboratory, Dental Investigations, Preventive Services Initiative Hyperbaric Medicine, Occupational Medicine

- USAF School of Aerospace Medicine used DHP funding
  -- Conduct 61 Aerospace Medicine courses, graduating 4,768 students
    --- aerospace medicine, aerospace nursing, aerospace physiology, public health, bioenvironmental engineering
  -- Provide training education and consultation
    --- Human performance enhancement, contingency medical operations, occupational health, disease prevention, environmental quality, and aeromedical evacuation

- 70th Medical Squadron received DHP funds to provide the following services
  -- Primary medical services, dental care, aeromedical services, family advocacy, mental health for eligible beneficiaries

- Human Systems Program Office received DHP funding for the implementation of the Composite Health Care System (CHCS) in each Air Force Medical Treatment Facility

Document Separator

ARMSTRONG LABORATORY

MEETING THE HUMAN CHALLENGE
GLOBAL POWER - GLOBAL REACH

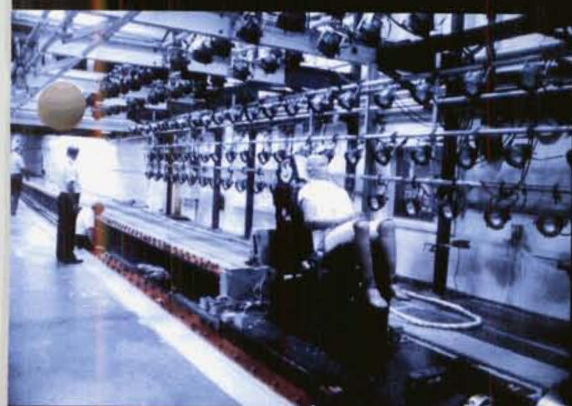
Research and Development

Beyond the requirement for a reconstitution capability, is the compelling need for continued and significant R&D in a wide spectrum of technologies, applications, and systems. As with the training and overall readiness of our military forces, there can be no false economies in this critical area.

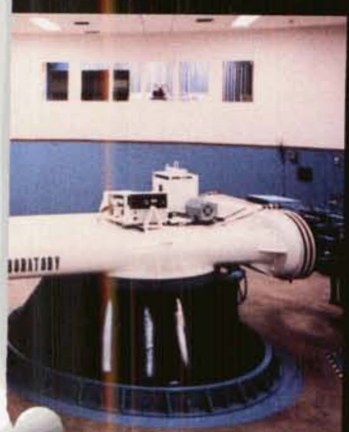
Excerpted from The National Military Strategy of the United States

Aerial View - Armstrong Laboratory

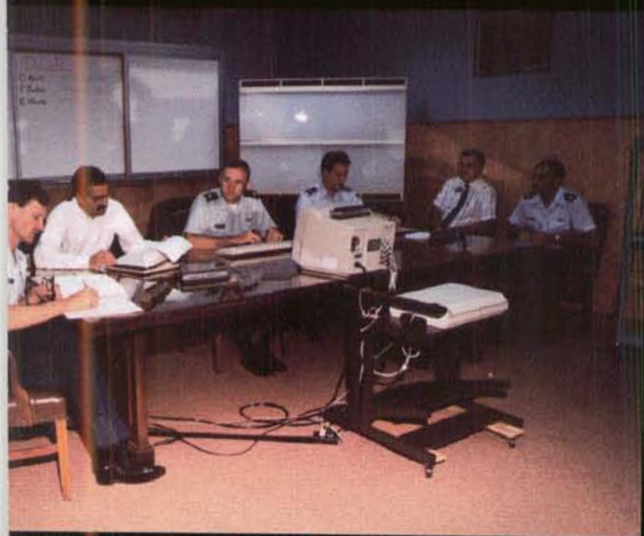
Maj Gen Harry G. Armstrong
First Director - Aeromedical
Research Laboratory



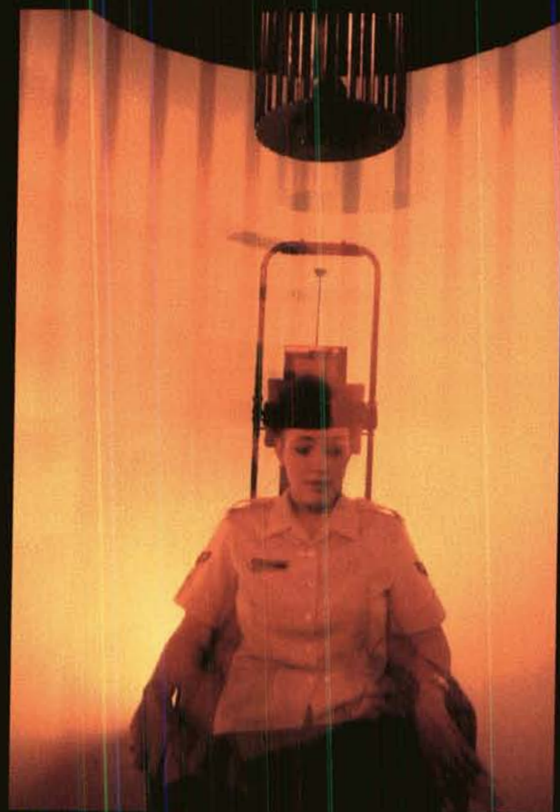
Horizontal Sled



Ultra-Short Pulse Laser



ase Discussions



Vestibular Function And Eye Tracking Research

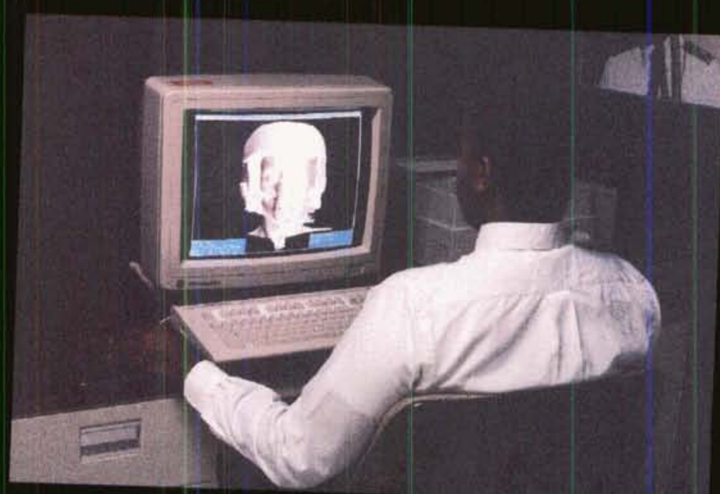
rch: Laboratory Services

Hyperbaric Medicine

or Tactical Environments

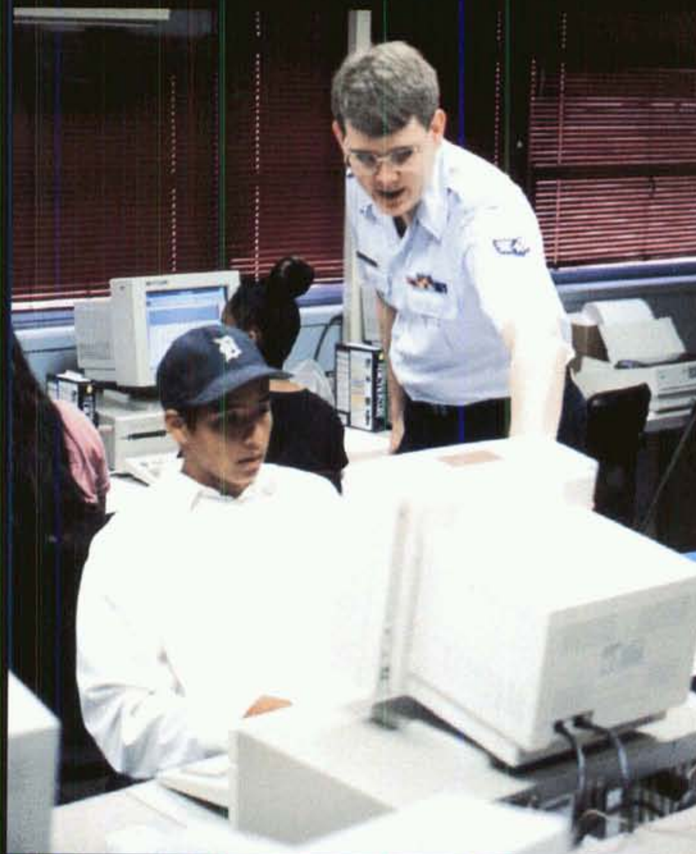
Vertical Drop Tower

e ircraft Systems Simulator



Anthropometric Research and Design

Integrated Maintenance Information System (IMIS)



Fundamental Skills Training

ic Attributes Test (BAT)

Virtual Reality Research

HEALTH

ental Sample Analysis

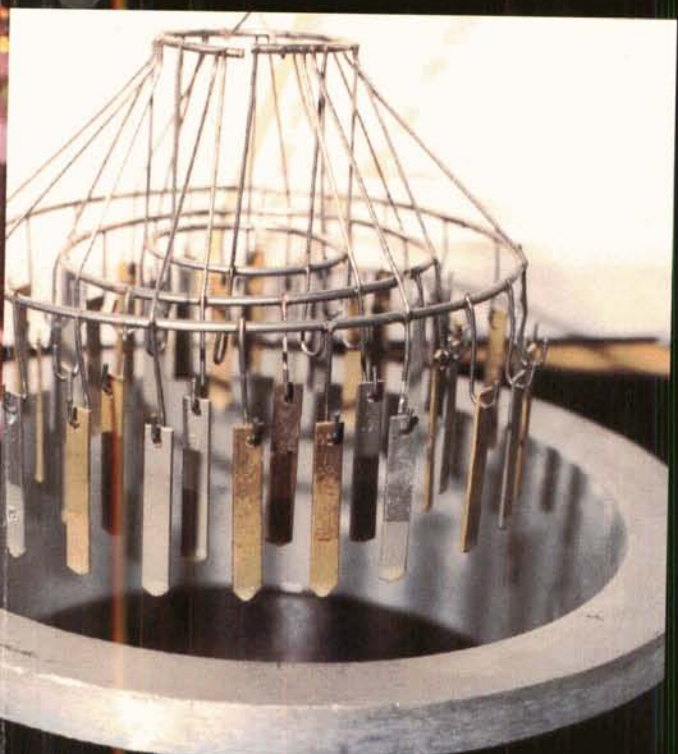
Hazardous Waste Health Risks

Pulse Laser Research

Occupational Health Assessment

g Process

Computer Modeling R&D Of Launch Vehicle Explosions



Solvent Testing

Biodegradation Studies

Award-Winning Researchers

3-D Audio Display

work Performance Analysis

Molecular Sieve Oxygen
Generating System

Document Separator

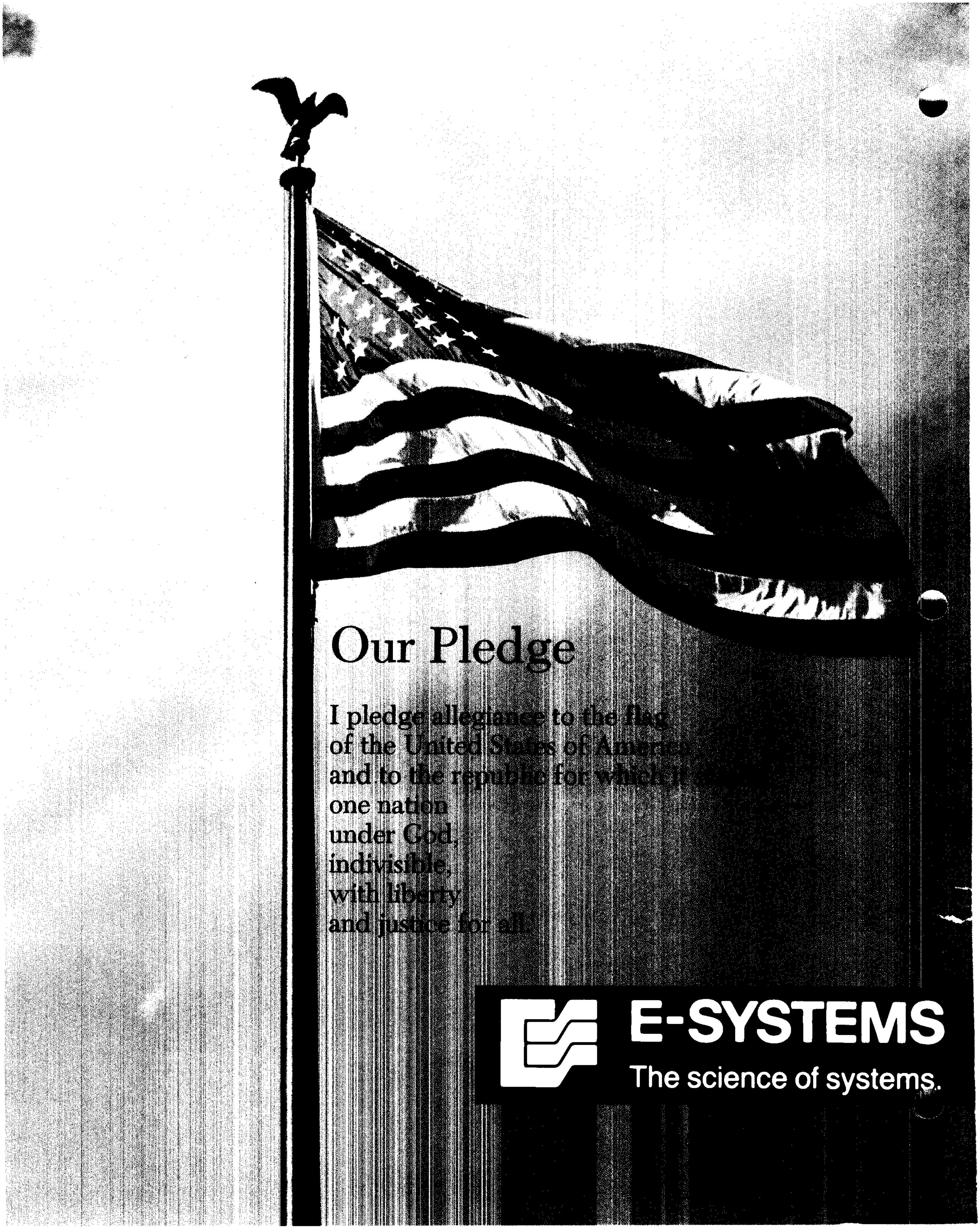
COMMEMORATIVE PROGRAM

PRIDE IN THE PAST ★ FAITH IN THE FUTURE ★

BROOKS AIR FORCE BASE

75

1917 - 1992


Our Pledge
I pledge allegiance to the flag
of the United States of America
and to the republic for which it
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under God,
indivisible,
with liberty
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Cover: Major Henry C. Pratt, the first commander of Brooks Field, standing in front of his JN-4 (Jenny).

Brooks Air Force Base Commemorative Program

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Brooks Heritage Foundation

The Brooks Heritage Foundation was founded in 1987 as a private non-profit organization to preserve the history and heritage of Brooks Air Force Base. The purpose of the Foundation is to make the public aware of the important role of aerospace research, development, and education in sustaining the national security of the United States. In addition, the Foundation will assist in developing and supporting Schriever Heritage Park, the Sidney J. Brooks Memorial, the USAF Aeromedical Evacuation Annex, and overseeing acquisitions for the Edward H. White II Memorial Museum in Hangar 9, which is dedicated to early aviation and flight medicine/research.

The Foundation is working to form a common bond that will unite those to whom Brooks has meant so much. This is being done in various ways, including building membership from around the country; helping Brooks preserve more of its heritage by restoring and refurbishing the World War II structure that houses the Aeromedical Evacuation Annex and its exhibit dedicated to 50 years of Flight Nursing; helping to complete the final phase of development of the Sidney J. Brooks Memorial; and finally, by helping Brooks Air Force Base celebrate its 75th Anniversary.

The Foundation wants those who have served and those who are now serving to have every reason to have ..."PRIDE IN THE PAST...FAITH IN THE FUTURE!"

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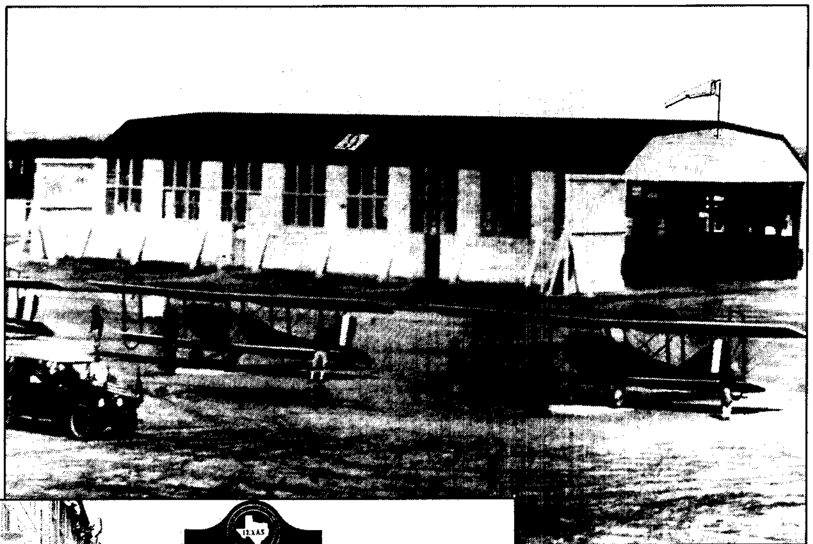
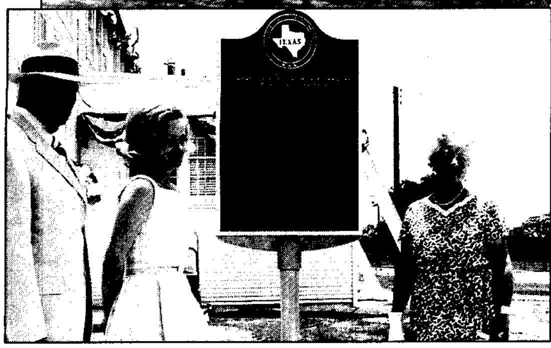
Edward H. White
Memorial Museum



Hangar 9 as it appeared in the early 1920's.



Parents and widow of Edward H. White at the dedication of restored Hangar 9 in 1970.

Built in 1918, Hangar 9 was one of sixteen original hangars built at Brooks Field. It remains the oldest aircraft hangar in the United States Air Force. With a combined base and community effort in 1969, Hangar 9 was restored and now houses the Museum of Flight Medicine and other related exhibits depicting the history of Brooks Air Force Base.' In 1970, Hangar 9 was dedicated as a memorial to Edward H. White II, a native of San Antonio, who lost his life in the Apollo I capsule fire.

In addition to housing the museum, Hangar 9 has become a popular place to hold social functions. Gourmet dinners are regularly held in the hangar and retirement receptions are held there following ceremonies at the Sidney J. Brooks Memorial Eagle.

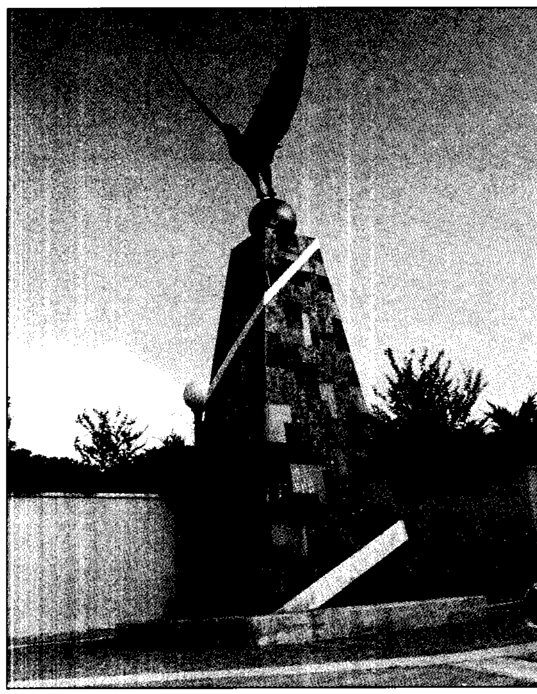
The hangar holds a special place in the hearts of all who have served at Brooks. The creaky windsock, still flying on the roof, is a constant reminder of the glory days of flying.

Sidney J. Brooks
Memorial Park

As part of the 70th anniversary of Brooks Air Force Base in 1987, a commemorative garden was dedicated to the memory of Sidney Johnson Brooks. Within this garden is a twelve-foot marble and granite monument topped by a five-foot bronze eagle. The monument and eagle were designed and sculpted by Lieutenant John Cmar, who was assigned to Brooks at that time. The park itself was constructed by volunteers from the base community, both civilian and military. At the dedication on November 13, 1987, several members of Sidney Brooks' family were present and the monument was unveiled by Major General (Retired) Eugene Eubank. While a lieutenant in flight training, General Eubank served as a pall bearer at Lieutenant Brooks' funeral.

On a plaque at the base of the eagle is an inscription that reads:

"To all the U.S. Airmen (Officers and Civilians) of those early years, few in number, great in spirit—the seekers, the pathfinders, the builders. They dared the heights and saw beyond their times."
-Anonymous



Schriever Heritage Park

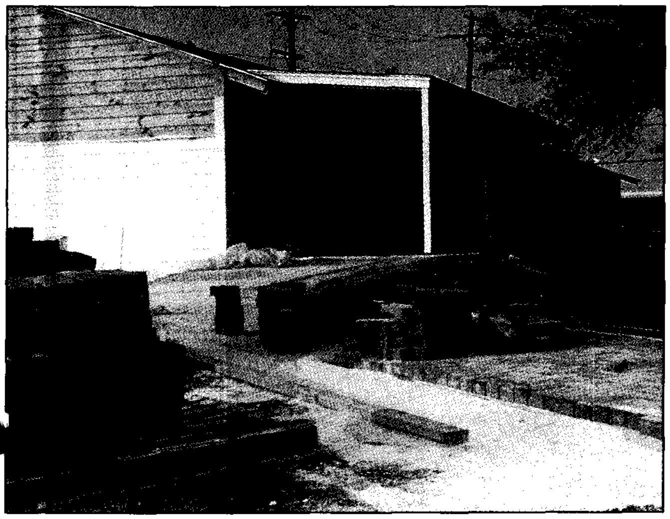
In October 1986, the Aerospace Medical Division (AMD), now the Human Systems Center (HSC), celebrated its 25th anniversary. During the celebration, a special ceremony took place—the dedication of Schriever Heritage Park, named for General (Retired) Bernard A. Schriever, first commander of the Air Force Systems Command (AFSC). The park features a mounted F-100F Supersabre replica of AMD's "Weightless 2" aircraft which was used in early astronaut weightless training.

General Schriever was born in Germany and moved with his family to New Braunfels, Texas when he was seven years old. He received his early education in San Antonio and graduated from Texas A&M in 1931. He began his military career the same year in the Field Artillery. He entered flight training at Randolph and received his wings and commission as a second lieutenant. He completed a degree in aeronautical engineering at the Air Corps Engineering School and a master's degree in mechanical engineering (aeronautical) at Stanford University.

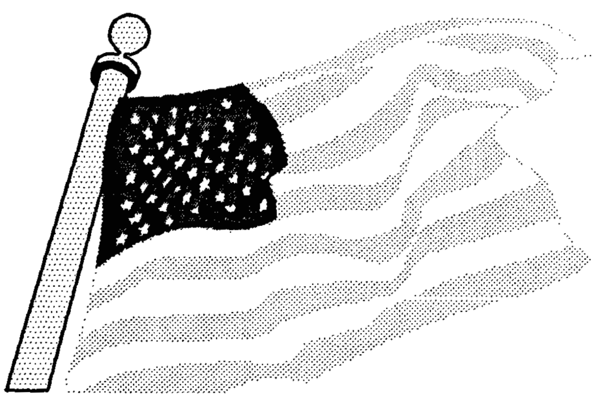
In June 1954, General Schriever was named the commander of the Air Research and Development Command. In this capacity, he directed both the nation's highest priority project—the development of the intercontinental ballistic missile program—and the development of the Air Force's initial space programs.

General Schriever became the driving force for the creation of the Aerospace Medical Division within Air Force Systems Command, thus consolidating all the life and behavioral sciences for aerospace support. General Schriever believed this integration would command facilities so comprehensive and well established that the Aerospace Medical Division would become the human systems advocate for the nation, the Air Force and the entire free world. In time, this division would change its name to the Human Systems Division (and later HSC), signifying its emphasis on programs that integrate human factors into the design, development, testing and operations of Air Force Systems.

USAF Aeromedical Evacuation Annex



To commemorate the 75th Anniversary of Brooks Air Force Base and to honor 50 years of Flight Nursing, the Brooks Heritage Foundation moved, renovated and refurbished a World War II structure (Building 754) to house the Aeromedical Evacuation Annex to the Edward H. White II Memorial Museum. The building, located adjacent to Hangar 9, will contain memorabilia relating to the history of Aeromedical Evacuation and Flight Nursing, but also will be the site of the "Honor Wall" recognizing those individuals and corporations that helped make the museum a reality. Leading from the Annex there is a Memorial Walkway with engraved paving stones recognizing current and de-activated Aeromedical Evacuation Squadrons, as well as individuals, corporations and Life Members of the Brooks Heritage Foundation. The building was formally presented to Brooks Air Force Base by the Brooks Heritage Foundation on November 13, 1992 on the 75th Anniversary of the death of Cadet Sidney Johnson Brooks. (Building and Memorial Walkway under construction).



Sidney J. Brooks Jr.

The death of Sidney J. Brooks Jr. all those decades ago remains, in many ways, a mystery.

A cadet aviator at Kelly Field, he was making the short flight back from Hondo on November 13, 1917, when his JN-4A aircraft suddenly plummeted.

Brooks, on his final flight prior to being commissioned as a first lieutenant, became the first San Antonian to die in World War I activities.

His friends and officials with the American Flying Corps speculated at the time that Brooks may have fainted in the cockpit, his body stressed out from an anti-typhoid serum injection he had been given earlier in the day.

Medical science at the time knew little about the strain flying can put on the body. Today, the problems of space medicine are routinely tackled in the laboratories at Brooks Air Force Base, named for Brooks three months after his death.

The base, located on San Antonio's South Side, is headquarters for the Air Force Human Systems Center, which includes the School of Aerospace Medicine, among other missions. It provides medical education and services to test human performance.

Brooks was born in San Antonio, graduating from high school here in 1913 and entering the University of Texas at Austin the following fall. He fell ill in January 1915 and returned to San Antonio, where he joined the staff of the San Antonio Light as a reporter.

With war brewing in Europe, Brooks entered the Citizens' Training Camp in the summer of 1916.

Eager to become a military aviator, he attended the required ground school in Austin before transferring to Kelly Field to complete his training.

Progressing through the ranks, he lacked only a final, cross-country flight to receive his commission as a first lieutenant.

He and several other cadet aviators had flown to Hondo, about 40 miles from San Antonio, on November 13, 1917. After a short rest, they began their return to Kelly Field. Brooks' craft was approaching the edge of the landing field when it abruptly turned nose down and crashed.

The crash shocked Brooks' survivors, but some reported eerie premonitions of his death.

Stuart McManus, a longtime friend who worked as a night clerk at the Menger Hotel, told mutual friends that Brooks had visited him the night before the fatal crash. Brooks, McManus said, was worried he would not be able to solo successfully.

McManus assured his friend he would do fine.

The young aviator's fiancee, Lottie Jean Steele, later spoke often of her feeling that Brooks had reached out to her as his plane crashed.

She was in the backyard of her Terrell Hills home that afternoon, she said, when she heard Brooks twice call out to her. Several hours later, she heard that he had crashed, just at the time she heard the call.

A garden on the grounds at Brooks — a memorial to the base's namesake — was completed for the 70th anniversary celebration for the Air Force base in 1987. Within its grounds is a 12-foot marble and granite monument topped by a five-foot bronze eagle.

The inscription reads:

"To all the U.S. Airmen, (Officers, and Civilians) of those early years, few in number, great in spirit — the seekers, the pathfinders, the builders. They dared the heights and saw beyond their times."

Brooks Field
1917-1948

A history of Brooks AFB is in a real sense a history of American military aviation. Being one of the oldest continuously active U.S. air bases, Brooks has been the site of a number of important events in aviation history. From its first mission, the training of Army pilots, Brooks has evolved into one of the world's largest aerospace medical research centers, and serves as a human-centered advocate for the Air Force in weapon system design and development.

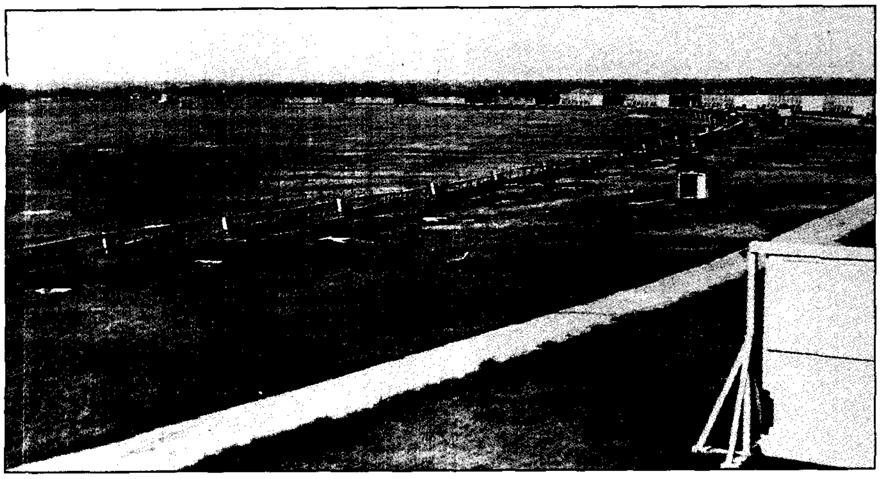
Brooks was a war baby, born of necessity to train pilots for World War I duty. Ground was broken for the facility on December 8, 1917 and it was formally established under the command of Major Henry C. Pratt on February 16, 1918. The army was looking for a good location for a new flying field where changing seasons would not interfere with training schedules. While the fields around San Antonio were being selected and planned, a delegation of French and American aviators from the front lines were sent to Brooks to approve the layout and construction. The site of 873 acres was so heavily covered with mesquite and undergrowth that the Military Affairs Committee of the Chamber of Commerce constructed a tower overlooking the land so the inspection officers could better view the terrain. When complete, the field was small, runways were merely packed dirt and the planes used were the JN-4 (Jenny) type.

Building plans for the base were generated by the Detroit architectural office of Albert Kahn, who designed a curved 16-hangar line facing an open field with camp buildings arranged behind the flight-line to the north. A railroad entered the site from the northwest and ran to the supply buildings. All construction of the Base was of wood frame. Interestingly, one of the original aircraft hangars, now a Base museum, has the distinction of being the oldest wooden hangar remaining in the Air Force.

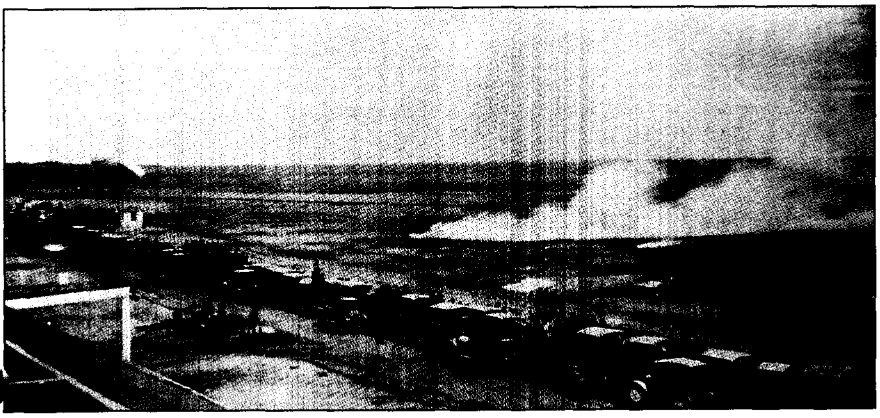
Brooks Field's first mission was to train Army flying officers as instructors in the Gosport System of flying instruction. The system, devised by the English Royal Air Force, was as simple as it was unique. It provided for a speaking-tube between the student-pilot and instructor to teach and correct the student while in flight. After the close of World War I, the Gosport School was closed, but its training methods were so successful that the War Department required that the Gosport System be made

Two aviators displaying the Gosport System. This system allowed the instructor pilot to talk with the student during training

The original staff at Brooks Field. Major Pratt, the first commander, is kneeling in the center.

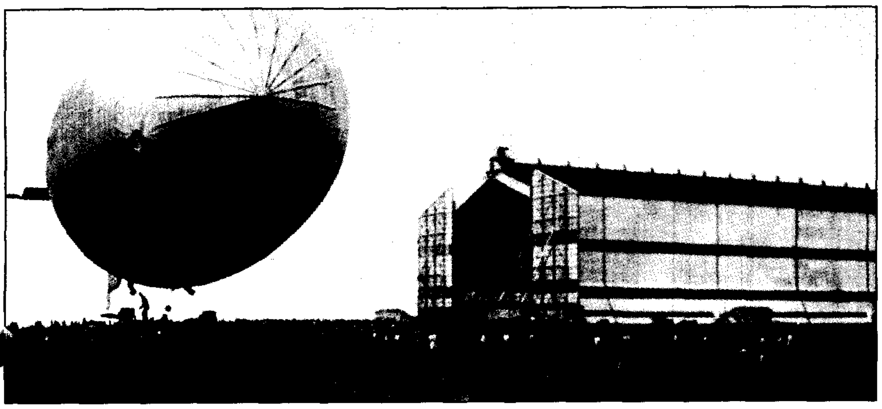


JN-4 (Jenny's) on the ground at Brooks in the 1920s.



Sham Battle, November 30, 1918

Hospital Ship preparing for action.



Balloon and hangar during airship days (early 1920s).

mandatory for all Army flying fields in the US.

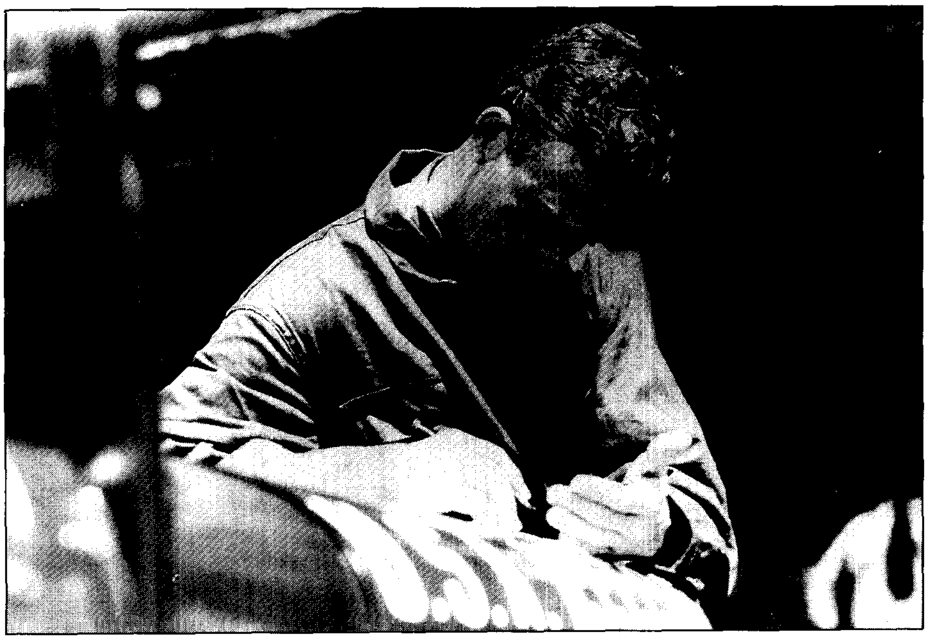
Brooks was formally named Brooks Field on February 4, 1918. The name Brooks was used to honor Cadet Sidney Johnson Brooks Jr. (1895-1917), who was the first native San Antonian to die in World War I-related activities. During its first year of operation, Brooks Field became the site of an American-German Sham Battle that first demonstrated the joint coordination of air power with the other Service Branches. Ten thousand spectators came to see the show.

After World War I, the Army developed a Balloon and Airship School at Brooks. Its new mission was to train pilots for lighter-than-air (hydrogen-filled) airships. A huge balloon hangar of over 91,000 square feet was constructed facing a half-semicircle arrangement of hangars. However, a series of disasters with these airships resulted in the suspension of these operations in June 1922.

Following the close of the Balloon and Airship School, Brooks became the Primary Flying School for the Air Corps. The first class consisted of 183 students with a one-to-six ratio of instructors to students. Soon basic training was added to flight training. Students were trained for four months in each area. Although the number of cadets eliminated for deficiencies was high, some of the most renowned names in military and civil aviation took their flying lessons at Brooks. Among its notable graduates were Charles Lindbergh (the first man to make a solo trans-Atlantic flight), Nathan Twining, and Thomas D. White. Other noted fliers were Robert G. Breen, R. C. Candee, Barry F. Giles, Willis H. Hale, Marvin E. Gross, F. V. Kimble, L.C. Craigie, and David M. Schlatter.

Among the more noted instructors were Claire Chennault, leader of the "Flying Tigers," who wrote the first two texts of flying instruction and also set an open cockpit altitude record of 40,800 feet; Russell Maughan, first pilot to make a "dawn to dusk" flight across the U.S.; Captain W. C. Ocker, first "blind flight" instructor; and Lieutenant Carl J. Crane, who wrote the world's first manual for instrument flying. In addition, Elwood Quesada became a pioneer in mid-flight refueling. Many pilots who trained at Brooks became senior officers of commercial airlines, and many more became airline captains. Dozens of student fliers finished their military service wearing four stars. An equal number became air commanders of World War II.

Charles Lindbergh



Charles Lindbergh (1902-1974) was born in Detroit, Michigan and grew up in Minnesota. At 20 years of age he took his first airplane flight and first parachute jump. The following year he bought his first airplane, a surplus Jenny, for $500 and learned to fly. He enlisted in the Army as a cadet in 1924, and completed the courses on military flying at Brooks and Kelly Fields.

When he began his primary training at Brooks, he already had 325 hours of flying time. When he reported for duty in his own battered war surplus Jenny, he was told in very strong language to get the contraption off Brooks Field. To everyone's surprise he was able to take off and fly to nearby Stinson Field.

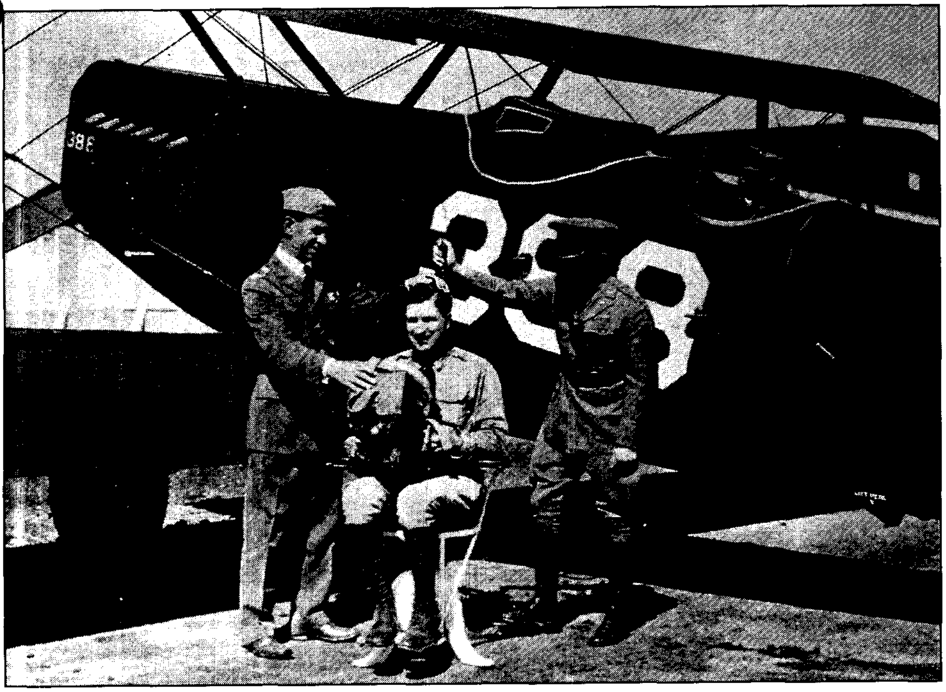
Upon graduation, Lindbergh was rated as an airplane pilot and commissioned a second lieutenant in the Air Corps Reserve. He helped fly the airmail when the military took over that responsibility. In his world-famous solo flight across the Atlantic in a Ryan monoplane, Lindbergh flew the 3,610 miles in 33-1/2 hours. He was an international hero from the moment he touched down in Paris. The plane, built on special order for Lindbergh, was powered by a 223-horsepower Wright J-5-C engine, and carried 450 gallons of fuel. In recognition of his courageous trans-Atlantic flight, Lindbergh was promoted to colonel and awarded the Distinguished Flying Cross. He received numerous other decorations and awards around the world.

Lt. L. C. Craigie

Lieutenant L.C. Craigie- first military aviator to fly America's first jet: the Bell XP-59. He received his wings at Brooks in 1924. On his recent 90th birthday, Lieutenant General Craigie flew right seat in a B-25 that led a formation of P-51's in a fly-by over March AFB. He plans to try it again in another 90 years!

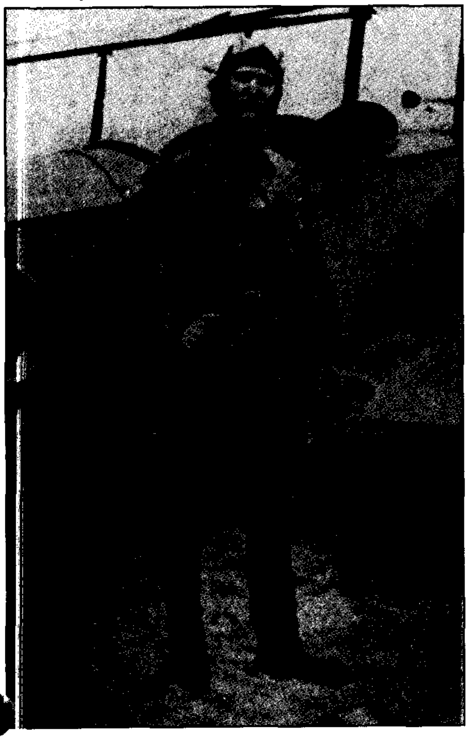
Below: Charles Lindbergh and Claire Chennault (third and fourth from left) during their days at Brooks.

William C. Ocker



William C. Ocker and unidentified Brooks personnel demonstrating the Ocker Box to pilot sitting in a Barany Chair.

Maj. William R. Ream



Pioneer flight surgeon and first to die in an aircraft accident. (World War I).

One of the great pioneers of aviation was Col. William C. Ocker (1880-1942), known as the Father of Instrument Flying. In fact, 1990 marked the 60th anniversary of the Army Air Corps' adoption of instrument flight instruction as advocated by Col. Ocker.

In 1912, Col. Ocker joined the aviation section of the Signal Corps, where he remained for the rest of his military career. He began his career as a corporal in aviation mechanics, developing an intense interest in flying. He spent his off-duty hours lending mechanical expertise to the Curtiss Company Flying School, and they appreciated his help so much that they taught him how to fly. Ocker qualified for a pilot's license from the Aero Club of America in 1914, and thus became one of the elite, a flying sergeant.

Instrument flying, at first called blind flying, meant flying without being able to see the ground, either because of cloud cover, night flying or fog. Pilots had fuel and altitude gauges on some of the earliest planes, but no instrument displayed the orientation of the aircraft. This shortfall caused many pilot deaths. One of the main problems of early aviation was the macho image of the pilots, who believed their natural instincts were better guides than any instrument aids. Ocker noted that it was a sign of weakness for pilots to admit they needed instruments to fly. He recalled that expert pilots could "fly by the seat of their pants" in fine sunny weather, but not in blind flight conditions.

Flight surgeons were aware of pilot disorientation and vertigo, but they were unable to offer solutions to the problem. Ocker came up with an answer by inventing a device later called the Ocker Box. The box contained a bank and turn indicator, a compass and a flashlight. The entire device could be mounted on a Barany Chair. When a subject viewed the instruments in the box while the chair rotated, the instruments indicated the correct movements even though these movements were at odds with human senses. This concept, when used on an airplane, permitted blind flying in adverse weather conditions, thus establishing the importance of instrument flying.

Ocker found it difficult to convince many older pilots of the correctness of his findings. Nevertheless, he noticed that pilots who had once been trapped in fog or blind flying conditions were enthusiastic about the new method. To prove his faith in blind flying, Ocker, with a safety observer, successfully piloted the first cross-country trip with only instruments as his guide. This historic flight took place on June 24, 1930, from Brooks AFB to Scott Field, Illinois, a trip of about 900 miles.

It was not until World War II that instrument flying was firmly established in the military. Ocker's early efforts in instrument flight instruction were duly honored when Orville Wright wrote in 1934 that Col. Ocker was the "greatest missionary of instrument flying."

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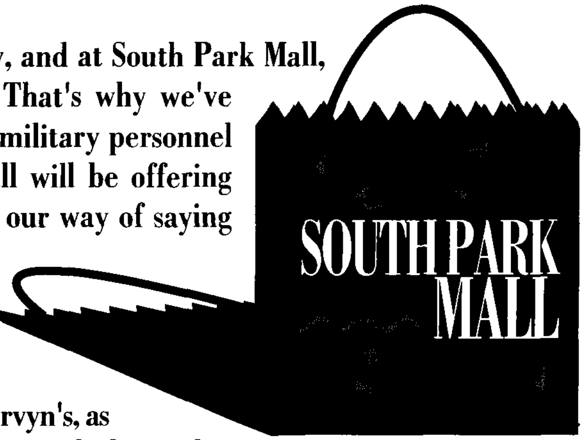

You've made a commitment to serve our country, and at South Park Mall, we think you deserve some service in return. That's why we've started the Preferred Service Card especially for military personnel and their families. Each month South Park Mall will be offering special programs designed especially for you, it's our way of saying thanks for the service you provide each and every day. Just stop by our mall offices to find out all the details, then take advantage of all we have to offer.

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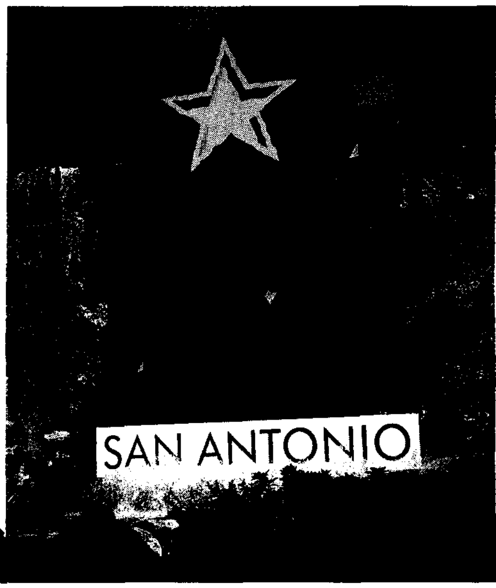
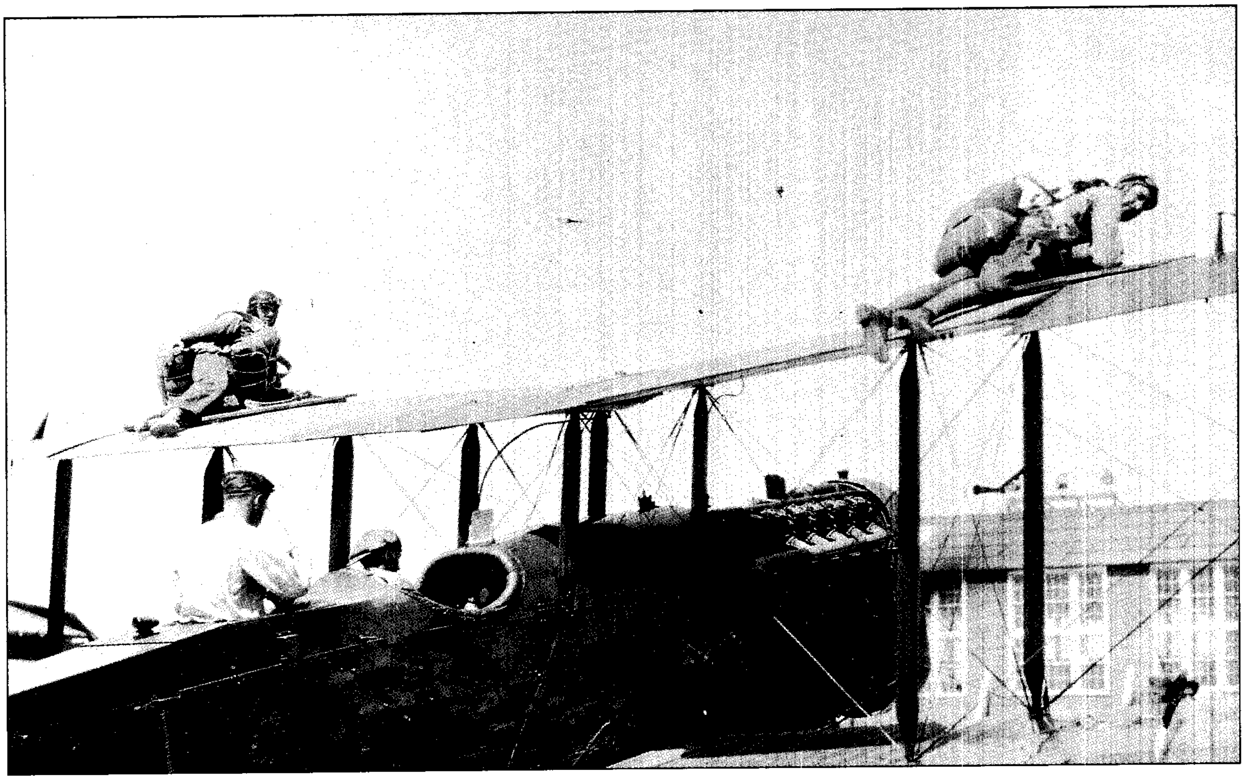
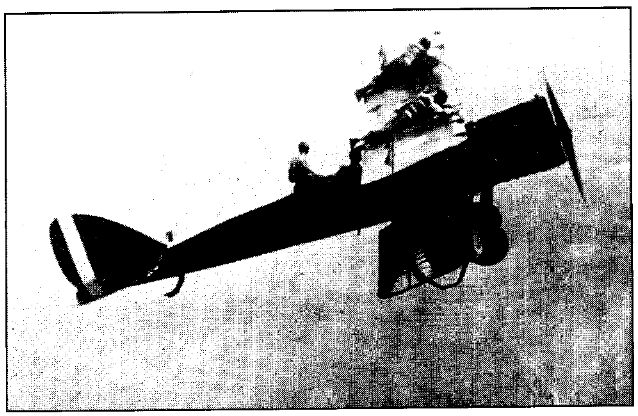
★ FIESTA TEXAS® SALUTES ★ BROOKS AIR FORCE BASE

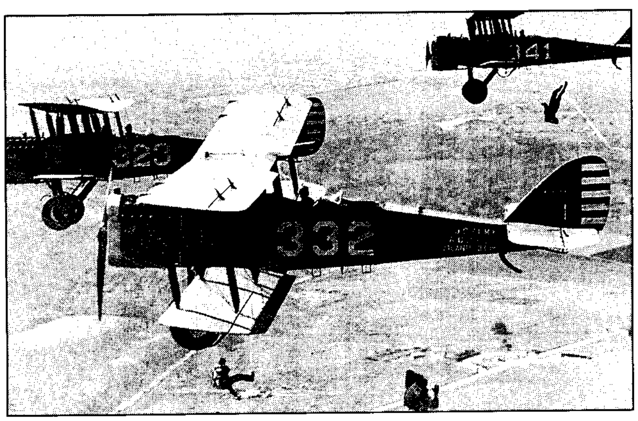
Fiesta Texas® joins all of San Antonio to salute the dedicated men and women of Brooks Air Force Base for 75 years of service. We applaud your efforts to preserve and celebrate a cherished heritage, for this has always been the prime inspiration for the creation of Fiesta Texas. Today we pause to honor the proud heritage of Brooks Air Force Base, and we wish all of you many more years of distinguished service to our country and community.



Paratroop Jump

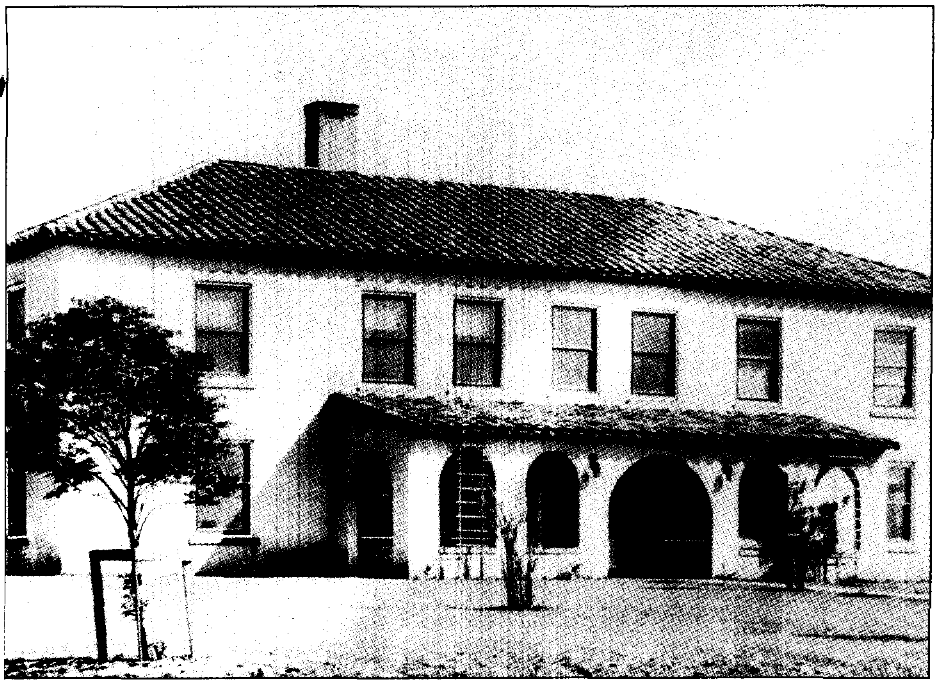






Paratroop jumps 1929

In 1928, Brooks Field became the site of early experiments in paratroop jumps, perhaps even the first paratroop jump, although there is some ambiguity concerning this record. Following a number of trial runs, an official paratroop demonstration was held for a large audience on September 28, 1929. Dignitaries were present from various world capitals. The demonstration included two formations of nine DeHavilands and three Douglas transports. The DeHavilands circled the field at 2,000 feet and dropped 18 men while the transports dropped three padded containers, holding machine guns and related equipment, from 3,000 feet. Four minutes after the leap, the machine guns were fired from positions on the ground. This demonstration confirmed the practicality of tactical paratrooper warfare, which would be used on many occasions during World War II.



First Brooks Field home of the School of Aviation Medicine. Now the home of the 648 Support Group Commander.

The School of Aviation Medicine

In 1922, the Air Service concentrated all of its flight training at two fields in San Antonio. Primary training was consolidated at Brooks, and advanced training was given to Kelly Field. During the nine years that primary training was at Brooks, there were 2,237 student graduates. Since flight training programs were accompanied by accidents, it seemed logical to place the School of Aviation Medicine where air training occurred. Orders directing the school to be moved from its former location in New York to Brooks Field in Texas were given in June 1926. The School moved into the first permanent structure at Brooks Field in 1927.

When the construction of Randolph Field in San Antonio was completed in 1931, the decision was made to relocate the School, along with the Primary Flying School, to the newly completed facility. At a time when other air fields were receiving new programs and the fortunes of the Air Corps in general seemed to be on the rise, Brooks had lost its two most important organizations.

Nevertheless, the successful integration of medical research, hardware design, and functional operation fundamentally shaped the evolution of modern aircraft and aviation equipment. The School was transferred back to Brooks in 1959 upon the consolidation of medical research and development activities.

Aerial Observation Center

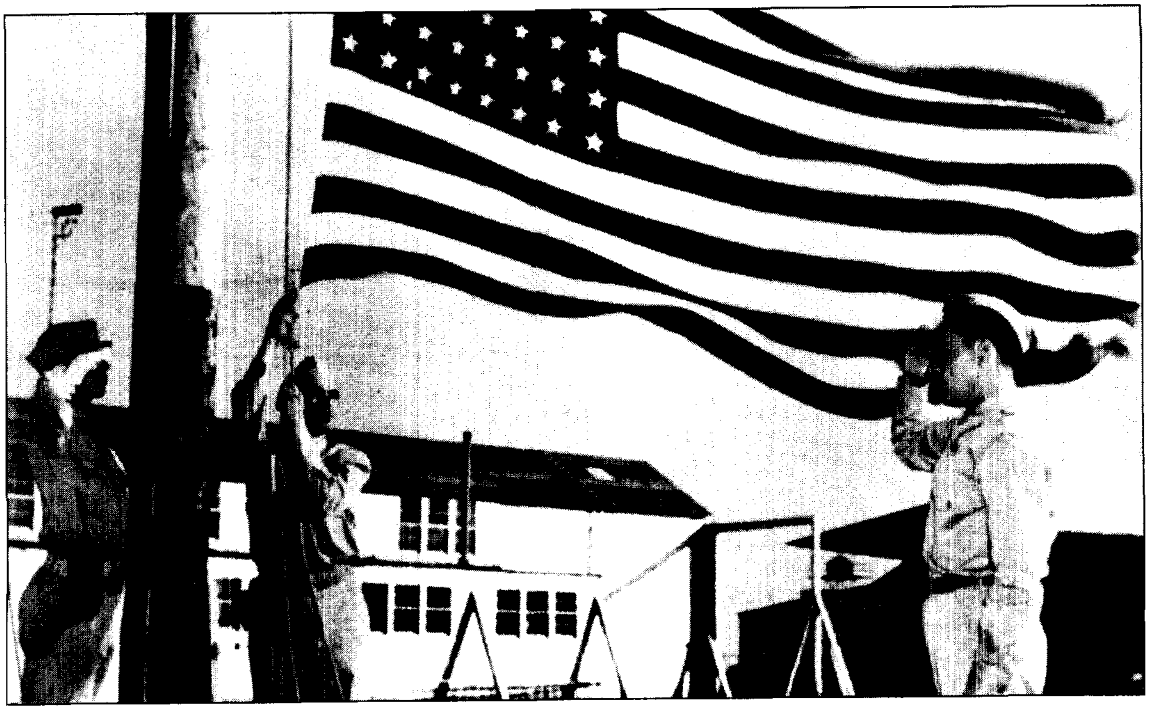
By 1931, a number of observation squadrons and a medical detachment had been transferred to Brooks Field. The observation focus of Brooks became the most hotly debated aspect of the Air Corps during these years.

One faction of the Air Corps considered observation to be an important auxiliary service. Another recommended more emphasis be placed on the primary services needed to secure control of the air (pursuit) and to destroy hostile targets behind enemy lines (bombardment).

By the early 1930s, proponents of bombardment had begun to make themselves heard. In 1933 the War Department concluded that an increase of combat and long-range reconnaissance planes and a corresponding decrease of observation and training aircraft were needed to rectify the perceived imbalance. By the late 1930s, most of the Group had been transferred, leaving only the 22nd Observation Squadron to become the foundation of future aviation activities at Brooks.

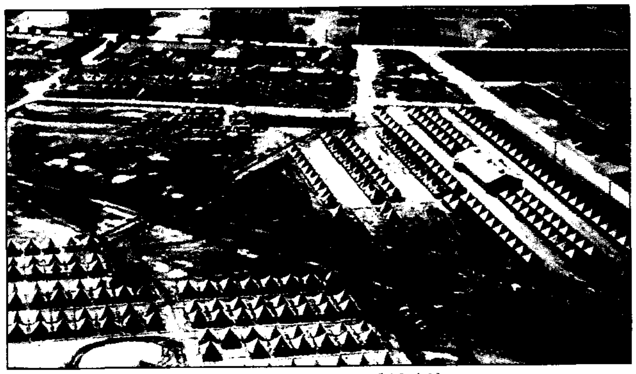
Brooks Field then entered a decade of low-profile activity that ended when the military threats of World War II became apparent. In fact, although some minor alterations had taken place, most of the original plan for the base had been preserved, so that on the eve of a new world war, Brooks Field epitomized World War I-era planning and architecture.

World War II



Private Joe McCord stands retreat, Brooks Field 1941

On watch at Brooks after Pearl Harbor 1941



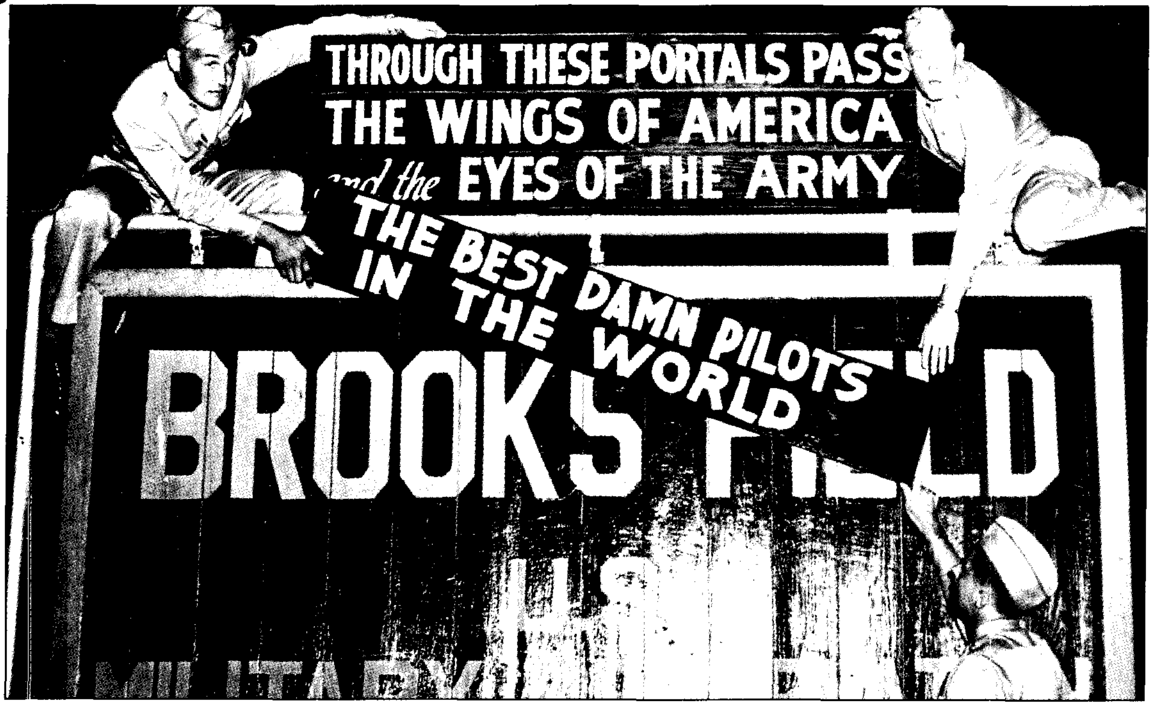
Brooks Field preparing for war (1941)

The quiet that had typified the 1930s was replaced at the end of the decade by the realization that war was inevitable. By September 1939, plans were finalized to establish an advanced program of flight instruction at Brooks to relieve pressure at Kelly Field.

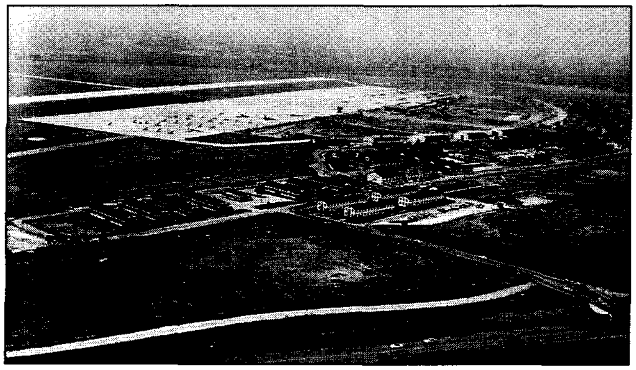
The School for Combat Observers at Brooks represented the continuation of the observer program that had begun with the Balloon and Airship School in 1919. During the early years of World War II, this program sought to train nonpilot military observers and pilot-observers. The mission of the School, which graduated approximately 50 Combat Observer pilots in three classes, was to prepare combat observers for aerial reconnaissance and support the ground troops by carrying cameras in stripped pursuit ships, or serving in bombing ships as a combination copilot, navigator, bombardier, photographer, radioman and aerial gunner.

By early 1941, it was clear that this effort at observation training was not adequate to meet the needs of modern aerial units. The curriculum in general was lacking, because war experience in observation had not been available for two decades and instructors were forced to draw heavily on obsolete methods and practices. The War Department then designated Brooks as the Army Air Force's Advanced Flying School (Observation) and a new program was instituted that placed observation training under the larger umbrella of the Advanced Flying School. Concurrent training of pilots and observers was instigated with stipulations that only fliers were trained as advanced single engine pilots and only nonpilots as observers.

Although new recommendations were offered that would be appropri-



Enthusiastic pilots at Brooks Field (1941)



Brooks Field in the late 1940s

Decontamination Unit practicing on a B-25 during WWII

ate to the needs of the Allies in World War II, the program was never the success envisioned. Many policymakers believed that the observation program was based on outdated World War I precepts rather than the needs of World War II. The view that nonpilot observation was of little help to the U.S. war effort and represented something of a military anachronism resulted in the discontinuation of observation training at Brooks Field in 1943.

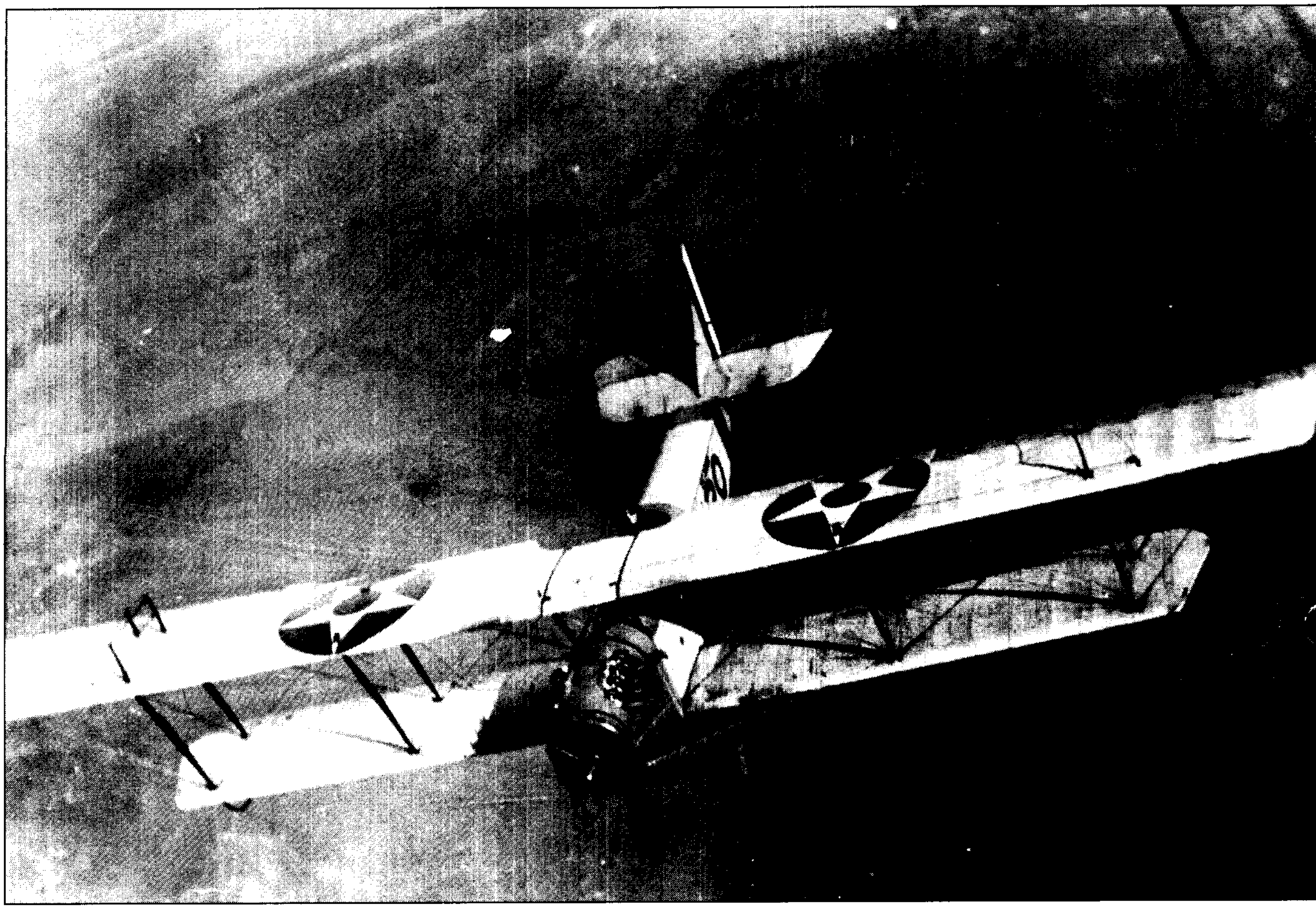
Although observation training at Brooks Field during the early 1940s was not a success, the advanced training program of military pilots between February 1940 and the end of World War II was a success. In January 1941 Brooks Field became home to an Air Corps Advanced Flying School that trained pilots to fly B-25s.

Participants in the Woman's Air Corps reported for duty at Brooks in 1943. The WACs replaced men, who were needed for combat, for clerical and hospital laboratory work, as well as for duty in the field's post office and bakery.

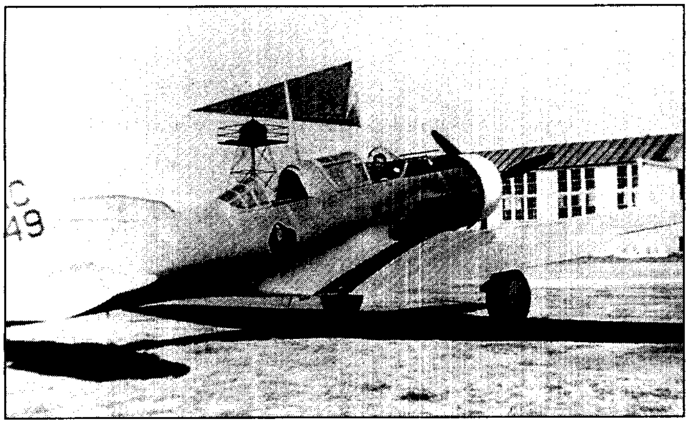
There were also great changes on the base. By the end of the war, the size of the field and the number of buildings at Brooks had increased dramatically.

Although pilot training ended in 1945, the immediate postwar years witnessed continued tactical and reserve flight activities at Brooks. Units from the 3rd, 10th, and 14th Air Forces were stationed here, along with the Alamo Wing of the Reserves and the 182nd Air National Guard Squadron. Air Evacuation flights of military patients were flown into and out of San Antonio from Brooks Field. But all flight operations at Brooks closed when the last plane took off on June 23, 1960.

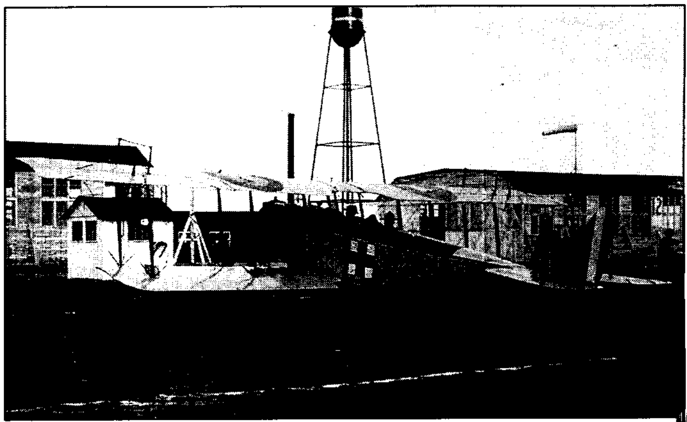
Brooks Aircraft



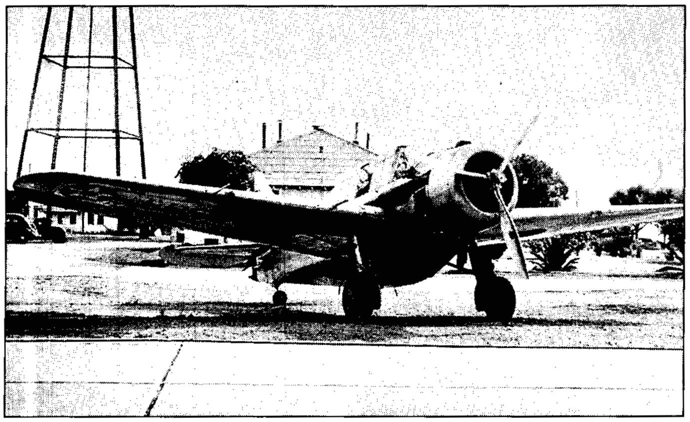
JN-4 (Jenny) in flight over Brooks in the late 1920s



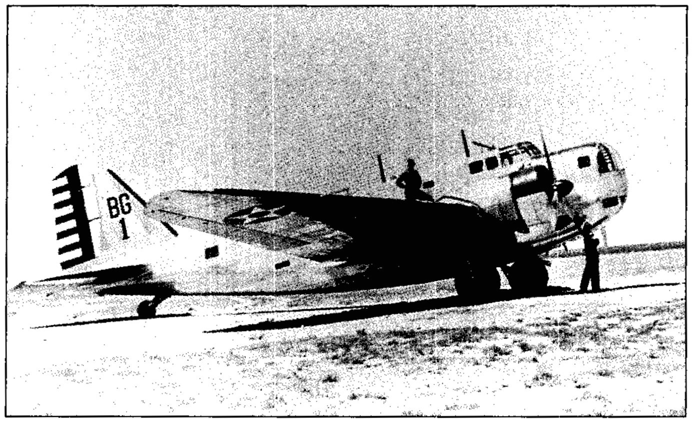
P-25 on the ground in the late 1930s



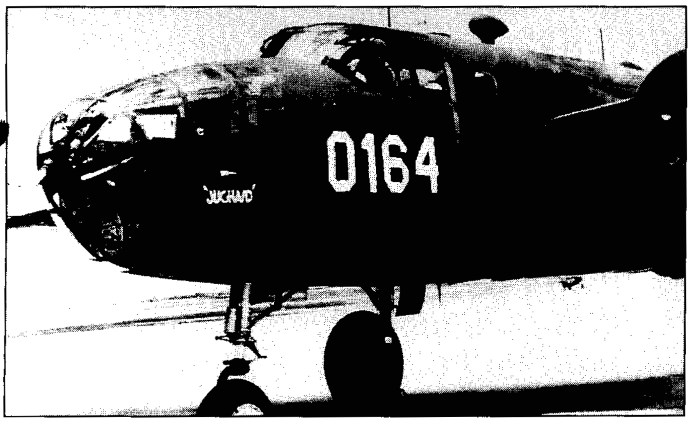
JN-4 (Jenny) configured as a hospital ship. It was the first military aircraft used for Air Evacuation.



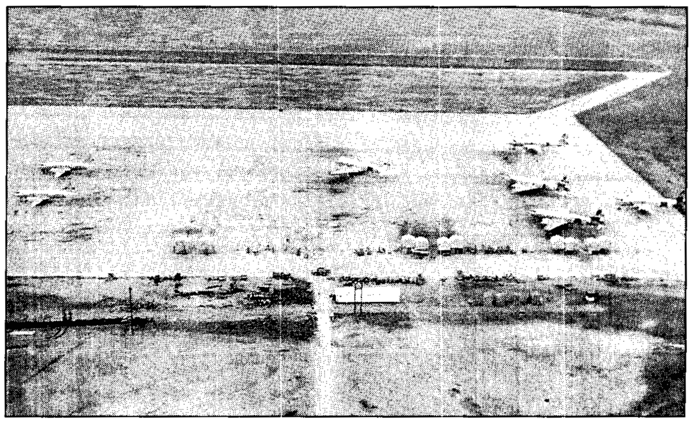
O-47A on the ground in 1938. These aircraft were used in Brooks' Observation Mission.



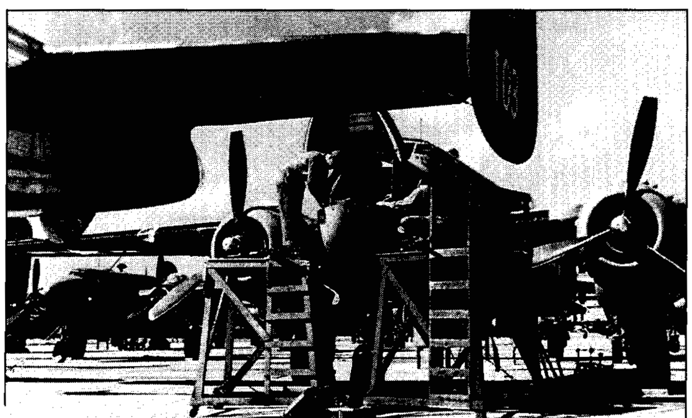
B-18 in the early 1940s



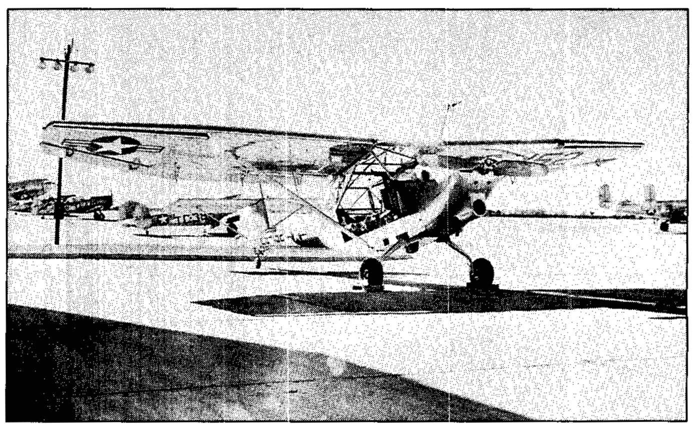
"Jughead", Brooks' most famous B-25



C-54 aircraft, used for air evacuation, on the ground in the 1950s.



B-25's and their maintenance crews, late 1940s



L-13 ambulance plane

Brooks Aircraft

B-26s on the line in 1946

B-26s in flight over Brooks in 1946

Brooks AirForceBase 1948-1990

School of AerospaceMedicine

Shortly after the close of World War II, the air arm of the U.S. Army became the U.S. Air Force. One of the immediate needs of the USAF was a medical service. Although technology had produced supersonic and stratospheric aircraft, man was the limiting factor in their use. Airmen were subjected to extremes of the environment and to emotional and physical stresses due to the growing complexity of aircraft.

Although the School of Aviation Medicine at Randolph AFB and the Aeromedical Laboratory at Wright-Patterson AFB were involved in aeromedical research, a single central organization was needed to combine aeromedical research, education, and training along with a clinical facility to care for injured pilots who were at that time scattered among Army hospitals.

The history of the School of Aviation Medicine and the School of Aerospace Medicine parallels the development of aviation medicine. When Sidney J. Brooks was killed in November 1917, little did anyone realize that his death would be the catalyst for a new specialty in medicine. Lt. Colonel Theodore C. Lyster, the first chief surgeon, Aviation Section, for the U.S. Army Signal Corps, directed the establishment of a medical research board to study the effects of aviation on pilots and the possible medical problems which could result from flying various aircraft. Aviation medicine was born.

The Medical Research Laboratory was opened in 1918 at Hazelhurst Field, Mineola, Long Island, New York. Its major emphasis was changed from research to education. Physicians, soon called flight surgeons, were trained in aviation medicine. In 1922, the laboratory's name was changed to the School of Aviation Medicine. It moved to Brooks Field in 1926 and remained there until 1931, when it moved across town to Randolph Field.

The school continued to train physicians in aviation medicine and did minimal research to support its studies. In 1945, the School of Air Evacuation merged with the school and began an expanded role in teaching aeromedical evacuation concepts to nurses, medical technicians and physicians. With the establishment of the United States Air Force as a separate service in 1947, the focus on aviation medicine as a unique specialty was renewed. Both programs moved to Brooks Air Force Base in 1959.

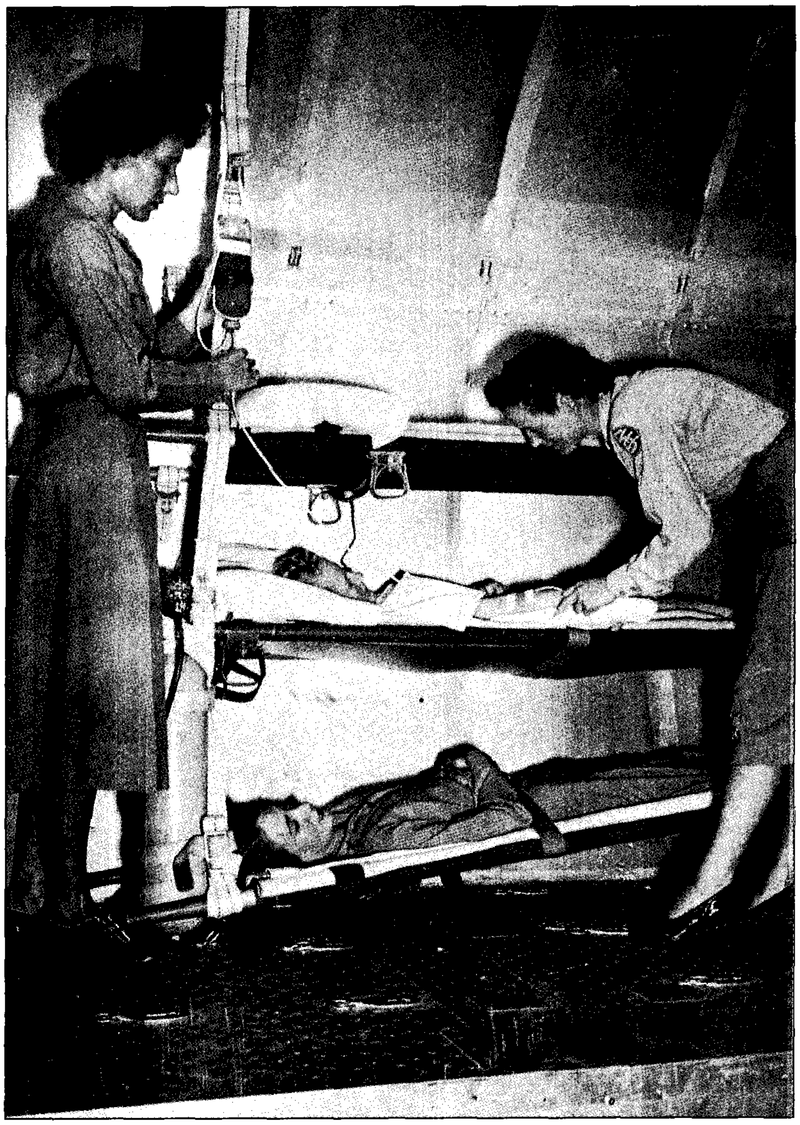
In 1961, the school was renamed the USAF School of Aerospace Medicine and became part of the Aerospace Medical Center. This action combined aerospace medical research, education and clinical treatment under one center designed to study flight and its effects on the individual, as well as the various systems which support the crew member while in flight.

Today, the USAF School of Aerospace Medicine is an integral part of Brooks Air Force Base. It is the sole Air Force training institution for the aerospace medicine program, flight nursing, environmental health (military public health), bioenvironmental engineering and aerospace physiology. The school is an internationally recognized educational institution, and participates in training and educational exchanges with many nations.

FlightNursing

Flight Nursing began as a concept in 1930 when a civilian pilot, flying over a town that had been devastated by a tornado, envisioned moving the sick and injured to medical facilities via airplanes while nurses and technicians cared for them. Lauretta M. Schimmoler formed the Aerial Nurse Corps of America with the purpose of providing trained and qualified personnel to fulfill her vision. It took twelve years before her concept became a reality, as the medical departments of the services and the American Red Cross would not fully endorse her idea.

Two incidents in January 1942 gave impetus to the development of flight nursing as an on-going entity. The first was the mass movement of sick and wounded soldiers from the Burma-Indochina region to the United States, which prompted Brigadier General David Grant, Air Surgeon for the Army Air Corps, to call for the development of a training school for nurses and technicians.



C-47 mock-up used in early 1940s for training flight nurses & technicians

The second came as a result of a flight from Karachi, India. During this flight, 2Lt. Elsie Ott served as the sole flight nurse on an aircraft loaded with patients that undertook a seven-day mission westward across Arabia, Africa and the southern Atlantic Ocean, to Bolling Field, Washington, D.C. Ott tended her charges with minimal assistance during the flight, and upon completion wrote down her recommendations for future flights. Many of her suggestions remain in place today as vital components of the Aeromedical Evacuation System.

In May 1942, the proposal for a School of Air Evacuation was developed and a call went out for volunteers from the Army Nurse Corps to train in this new nursing speciality. The School of Air Evacuation officially opened in October 1942 at Bowman Field, Kentucky. Two squadrons of nurses and technicians were trained, but due to the need for their expertise in North Africa and the Western Pacific area, they did not graduate. They departed Kentucky on December 25 for their respective areas of assignment. The first official graduation of flight nurses and medical technicians occurred February 14, 1943.

Since 1942, the School of Evacuation has been located at Bowman Field, Kentucky; Randolph Field, Texas; Gunter Air Force Base, Alabama; and Brooks Air Force Base, Texas. More than 11,500 nurses and 7,800 technicians have been trained in the specialty of flight nursing. Additionally, 17 nations have sent nurses and technicians to learn the tech-

C-9 Trainer at the Department of Aerospace Medicine.

Major Claire Garrecht, USAF, NC, comforting a patient prior to evacuation.

niques and skills required to care for patients in the airborne environment. Three nations have developed their own programs using the USAF as a model.

Flight nurses and aeromedical evacuation technicians provide care to the sick and wounded in a variety of aircraft: passenger, cargo, bombers and tankers. During the Korean War, two aeromedical evacuation squadrons were the first Air Force units to be awarded the Meritorious Unit Citation. Flight nurses moved the first patients out of Vietnam in 1954, airlifting injured French soldiers to France and Algeria following the fall of Dien Bien Phu. In 1975, flight nurses and medical technicians assisted in returning the Vietnam prisoners of war to the United States. During the most recent conflict, Desert Storm, flight nurses and aeromedical technicians used the Total Force concept, integrating medical crews from the active duty, reserve and guard forces. They provided in-flight patient care on three different aircraft in the Theatre of Operations, Europe and the United States.

Flight Nurses and aeromedical evacuation technicians also have given their lives in the performance of their duties. Seventeen nurses and 13 technicians were killed during World War II. Three flight nurses were killed during the Korean Conflict. No nurses or technicians were killed during the Vietnam War; however, one nurse and two technicians were killed while airlifting orphans from Saigon during Operation Babylift. One flight nurse was a German prisoner of war in Europe; and 13 nurses and 13 technicians were forced to utilize the skills they learned in survival training when their aircraft crash- landed in Albania and they had to make their way to friendly forces in Italy.

Whether during periods of conflict or peace, natural disaster or individual emergency, flight nurses and aeromedical evacuation technicians have been there to ensure that people receive the best care possible while en route from the battlefield or hospital to a definitive care facility. Their area of responsibility knows no boundaries, as they have moved critically ill infants in the United States and severely burned teenagers from Russia to Texas for expert medical care. The Flight Nurse and Aeromedical Evacuation Technician programs look forward to the 21st century, when they will be able to utilize the latest developments in technology in a vibrant, yet youthful, program that reaches out to those in need while providing the highest quality patient care in the airborne environment.

Aeromedical Evacuation

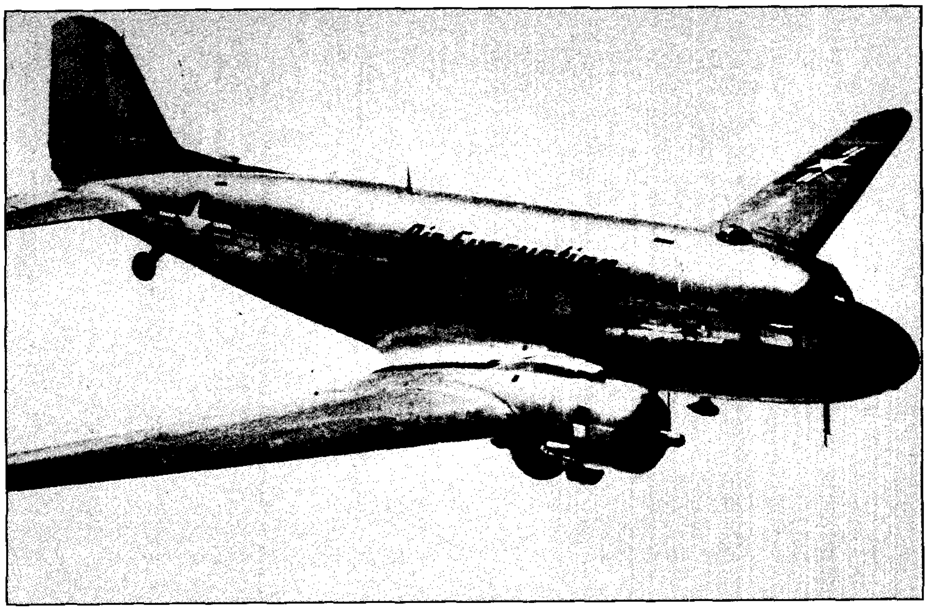
Legend has it that the first air evacuation of injured soldiers occurred during the Franco-Prussian War, when wounded men were airlifted in hot air balloons from the city of Paris. Whether fact or fiction, this act spurred the imagination of those involved in the development of the airplane.

The first ambulance plane was constructed in 1910, but failed to carry patients, as it crashed on its maiden test flight. The first actual air evacuation of wounded military personnel took place in April 1918 at Flanders, France, during World War I. At Gerstner Field, Louisiana, in February 1918, Major Nelson Driver and Captain William Ocker converted a Jenny biplane into an air evacuation aircraft. This was done to assist the return of pilots who crashed their planes in locations inaccessible to automobiles. The doctor could fly to the crash site, treat the pilot, and transport him back to a hospital for further care.

Between 1918 and 1930, eight different aircraft were either modified or specifically designed to be air ambulances. These aircraft could carry up to six stretcher patients and/or ambulatory patients depending upon the size and design of the aircraft. Most patients were transported on these aircraft with only the pilot in attendance. Despite this foray into the construction and utilization of airplanes for air evacuation purposes, military authorities did not support large scale use of aircraft for the transportation of the sick and wounded, nor did they assign or develop a cadre of personnel to accompany patients when being transported.

In the 1930s, some efforts were made in the civilian community to transport patients via aircraft. Due to the high cost it did not catch on, and with the advent of World War II many aircraft were utilized to support the war effort.

Brigadier General David Grant recognized the need for sick and wounded soldiers to be moved as quickly as possible, with competent medical care being given while they were airborne. So was born the School of Air Evacuation. Grant also conceived the idea of using transport planes, which



C-47- post World War II. This aircraft was used extensively during and after World War II to transport patients.

C-9 Nightingale, the first jet aircraft specifically configured for aeromedical evacuation.

BROOKS AIR FORCE BASE

1917-1992

The
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We thank
the men and women
at Brooks Air
Force Base
whose dedication
and service
have contributed
so much to our
community
and our country.

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BROOKS MEMORIAL
Photo taken during dedication ceremony on November 13. 1987. The occassion marked the 70th Anniversary of Brooks Air Force Base. The memorial is named for Sidney J. Brooks Jr. a native of San Antonio who died in an aircraft accident in 1917. the year the base was founded.

C-122 transport evacuating wounded during Korean conflict.

took supplies, and equipment to the battle areas, to bring patients back from the front for extended care.

During World War II, aeromedical evacuation crews airlifted over one million men from the front lines. General Dwight Eisenhower, following D-Day in Normandy, stated, "We evacuated almost everyone (350,000) from our forward hospitals by air, and it has unquestionably saved hundreds of lives, thousands of lives."

During the Korean War, aeromedical evacuation initially was not used, as ships transported wounded soldiers from Korea to Japan. However, following the airlift of 4,689 casualties over a hazardous five-day period, aeromedical evacuation became the preferred method of moving wounded soldiers from the combat area to hospitals in the rearward area.

In 1954, the first aircraft specifically designed to carry patients was introduced. The Convair C-131A Samaritan was, for all intents and purposes, a flying hospital. It could carry 37 ambulatory or 27 stretcher patients, or any combination of both. It was primarily used to ferry patients between military hospitals in the United States.

The first jet aircraft specifically designed for aeromedical evacuation entered into service on August 10, 1968. Since that time, the C-9A Nightingale has been the mainstay of peacetime aeromedical evacuation in the United States, the Pacific and European Theatres of Operation.

Long-range transport of patients in peacetime has been accomplished using the C-141 Starlifter, while the mainstay of wartime transport has been the C-130 Hercules.

Aeromedical evacuation is not just a wartime activity. During periods of peace, it is utilized to transport military personnel, dependents, retirees and Department of Defense personnel assigned overseas from small clinics/hospitals to large medical centers for extended and special care. Brooks Air Force Base was the hub of aeromedical evacuation in the 1950s and early 1960s.

Aeromedical evacuation also conducts humanitarian missions to transport individuals from anywhere in the world to medical centers offering specialized care. The recent transport of two severely-burned Russian teenagers from their homeland to Brooke Army Medical Center serves as a shining example of aeromedical evacuation's commitment to worldwide transport of the sick and injured, in times of peace, natural disaster or war.

The Space Years

President John F. Kennedy at the podium with M/General Theodore C. Bedwell, Lady Bird Johnson, Jackie Kennedy, and Vice President Lyndon B. Johnson.

On November 12, 1948, the first ever panel meeting to discuss medical problems of space flight was held at Brooks Air Force Base. The following year a Department of Space Medicine was created in the School of Aviation Medicine. It was the first advocated and was headed by Dr. Hubertus Strughold, "The Father of Space Medicine".

Progress in the space program depended on human subjects. Indeed, the first man to enter the space environment was the Russian, Yuri Gagarin, who launched into space on April 12, 1961. In the United States, the first manned space flights were those of the Mercury series. Many of the human subjects were Air Force basic trainees who volunteered for pressure chamber, isolation, and weightlessness studies.

One of the first was Airman Donald R. Farrell, a finance specialist stationed at Randolph AFB, Texas. In 1958, he volunteered to test the "space cabin simulator" that the School of Aviation Medicine had received in 1954. Although his seven-day stay in the tiny cabin seems tame today, at the time there were many unanswered questions, regarding the physical and psychological, on the effects of long-term isolation. The significance of the feat was highlighted by the fact that Lyndon B. Johnson, then Senate Majority Leader, was at Randolph AFB on February 16, 1958, to greet Airman Farrell when he emerged from the Chamber.

Consequently, there was a tradition of space research when the National Aeronautics and Space Administration (NASA) asked Brooks personnel to prepare a small life-support capsule for a Rhesus monkey (named Sam after the School of Aviation Medicine). In 1959, Sam, after being trained at Brooks to do simple tasks, was lofted into a research rocket, ejected in flight, and later recovered. The purpose of the flight was to test the escape system developed by NASA for the Mercury Astronauts. The success of this test and a following primate test confirmed the competence of Aerospace Medical Research at Brooks.

For four decades, the School of Aviation Medicine had focused its research, teaching, and clinical mission on the medical needs of the flier. Now it was proposed that the Center become the single agency for studies in the life sciences and aerospace medicine. Thus the Aerospace Medical Center became the Aerospace Medical Division in 1961, incorporating the USAF School of Aerospace Medicine (formerly the School of Aviation Medicine), much of the former Aerospace Medical Center and several other laboratories around the country. Brooks Air Force Base and its Aerospace Medical Division commanded virtually all Air Force facilities for aerospace medical research, development and testing; for postgraduate training of medical officers, nurses, and technicians in aerospace medicine and its related specialities; as well as for clinical diagnosis and treatment of fliers afflicted with disorders in these areas of medicine.

One of the most important events in the history of Brooks Air Force Base, and indeed the Aerospace Medical Division, was the visit of President and Mrs. John F. Kennedy on November 21, 1963. His speech that day focused the world's attention on the United States' commitment to put a man on the moon.

Kennedy Visit

November 21, 1963—The Texas air was crisp and clear at Brooks AFB as 12,000 people gathered to dedicate a new complex of buildings recently added to the USAF School of Aerospace Medicine. Tens of thousands lined the way from San Antonio International Airport, cheering as President John F. Kennedy made his way to Brooks to dedicate the new complex. His speech that day would be his last official act as President of the United States. Less than 24 hours later, he was killed by an assassin's bullets.

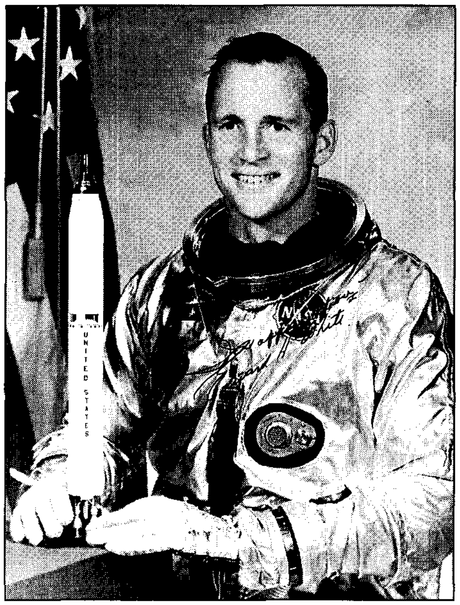
President Kennedy's address to the group gathered in front of the headquarters building of the Aerospace Medical Division was brief, but appropriately keyed to the business at hand - man's space effort. He praised the pioneers who manned the School of Aerospace Medicine and the Aeromedical Division, noting that these unsung heroes were making history every day.

In concluding his speech, Kennedy stressed the critical need to continue our space effort by quoting from Frank O'Connor, an Irish author. In one of his books, O'Connor tells how, as a boy, he and his friends would make their way across the countryside. When they came to an orchard wall that seemed too high for them to scale, they took off their caps and tossed them over the wall. Then they had no choice but to follow them up and over the top.

"This nation has tossed its cap over the wall of space—and we have no choice but to follow it...we will climb this wall with safety and with speed—and we shall then explore the wonders on the other side."

President and Mrs. Kennedy left for Fort Worth that afternoon. The next day, November 22, 1963, President Kennedy went to Dallas.

Edward H. White II



Edward H. White II was born in San Antonio, Texas. His father, an Air Force general, took him aloft in an old T-8 trainer when Ed was 12. No one ever questioned that the boy would become a flier. He graduated from the U.S. Military Academy at West Point in 1952. He earned a Master of Science degree in Aeronautical Engineering from the University of Michigan in 1959. After attending the Air Force Test Pilot School at Edwards AFB, he was selected as an astronaut by NASA in September 1962.

His great moment came in 1965 when he was selected to pilot the Gemini 4 space mission, a four-day event that began on June 3. This space mission circumnavigated the earth 62 times.

During the third revolution, Ed White opened the hatch while his spacecraft was over the Indian Ocean. He stood in his seat and fired his "zip gun" thruster and became the first American to "walk" in space.

Returning to earth after the successful mission, White said: "I felt so good, I didn't know whether to hop, skip, jump, or walk on my hands."

Two years later, tragedy took the lives of astronauts Ed White, Roger Chaffee, and Gus Grissom. While preparing for a pre-launch Apollo I mission on January 27, 1967, an electrical spark ignited combustible materials in the pure-oxygen atmosphere of their cabin. The three perished in the fire.

Although space-related endeavors waned at Brooks in the 1970s, some projects continued. Studies were conducted on nuclear survivability, decompression, sustained accelerative forces, cardiographic and other medical data for NASA's space shuttle system, as well as for other space research.

In the early 1980s, Brooks began its Military Space Biotechnology program, using the space shuttle to conduct medical experiments in space. Researchers at Brooks explored the need for crew protection and performance enhancement for men in military space systems. An operating location was established at the Johnson Space Center in Houston to improve coordination with NASA.

Some of the first experiments involved tests in visual functions, since astronauts had noted both increased and decreased ability to see in space. The goal of the tests was to predict vision changes and develop methods to minimize decrements. Also in the 1980s, a short-arm centrifuge for space application was studied as a method to prevent the physiologic deconditioning of space caused by weightlessness. The current protective measures employed in the shuttle's extra-vehicular operations evolved directly from 20 years of joint studies by NASA and Brooks pesonnel on altitude decompression sickness.

Current work at Brooks attempts to develop medical protocols for treatment of exposure to the vacuum of space (ebullism). Beginning in 1991-92, all astronauts were trained for G exposure at Brooks. Additionally, a crew reentry anti-G-suit was developed at Brooks, as were oxygen toxicity studies.

Within a lifetime, the age of aviation was born and brought man to the moon. These achievements were possible with the support of aerospace medicine and the technology developed at Brooks AFB.

Vietnam & Force Modernization

The Vietnam War was an agonizing period in American history. America was not willing to use its full military potential to win the war and its continuation made it increasingly unpopular. American military advisors were already serving in Southeast Asia when the Aerospace Medical Division (AMD) was established at Brooks Air Force Base in 1961. They contributed to the war effort by sending medical teams and dental operating units to the conflict area. Although it might seem odd for a medical division, they were involved in the early development of the gunships used in Southeast Asia. The aircraft allowed the pilot to operate rapid-fire guns that pointed out the side of the aircraft. Research for the side-firing Gatling gun was accomplished at AMD's Aerospace Medical Research Laboratory (AMRL) in Dayton, Ohio. When the Seventh Air Force asked for additional body armor protection, they synthesized mission data and wound ballistics and worked with body armor technologists to develop a new flak jacket.

Air evacuation became another significant Brooks contribution. Researchers developed advanced equipment to treat patients aboard aircraft, including therapeutic oxygen systems that provided some humidity for patients with respiratory difficulties. Other inventions were digital electronic thermometers and electronic stethoscopes that could be heard over the noise of aircraft engines. The School of Aerospace Medicine (SAM) aided in the development of the Modular Air Transportable Hospitals. SAM personnel also worked with members of the Army and Navy to develop joint-service prisoner of war medical evaluation forms and procedures.

As the United States began disengagement from Vietnam, it was a time of budget cuts, the Arab oil embargo, inflation and military downsizing. Military money could only go to projects with clearly defined customers that addressed operation problems. Brooks' research was narrowed from theoretical to applied. Yet, the base and its mission grew with the addition of the USAF Occupational and Environmental Health Laboratory (USAFOEHL) in 1976. Over the years, USAFOEHL developed the capability to analyze chemicals in virtually any substance. It gave advice concerning the actions and reactions of chemicals and responded to the site of any accidents, including those with the potential for radiation leakage. Additionally, Brooks personnel helped the Air Force's B-1 program by developing its oxygen generating system. Missile systems were also undergoing modernization, and the technical workforce continued its support for the ICBM through its research into the toxicity of missile fuels and ways of detecting leaks before they could injure launch site personnel.

Technology Transition

The Aerospace Medical Division at Brooks Air Force Base was a single point manager for all human-centered activities for aircrew effectiveness. Over the years, they enlarged and incorporated those laboratories whose mission was also human-centered. Thus, Brooks embraced the missions of research, teaching, health care, training selection and medical support for crew effectiveness activities. In essence, this technical organization assumed the unique position of surveillance over the field of interest that the original Medical Research Laboratory of the Army Signal Corps established and maintained during World War I, and it would involve itself in the much more complex scientific community which had developed since World War II.

In the early 1980s AMD expanded its mission with the addition of a series of advanced engineering and development programs. Prior to this time, the division developed technology but did not control its programs past their basic research and exploratory development phases.

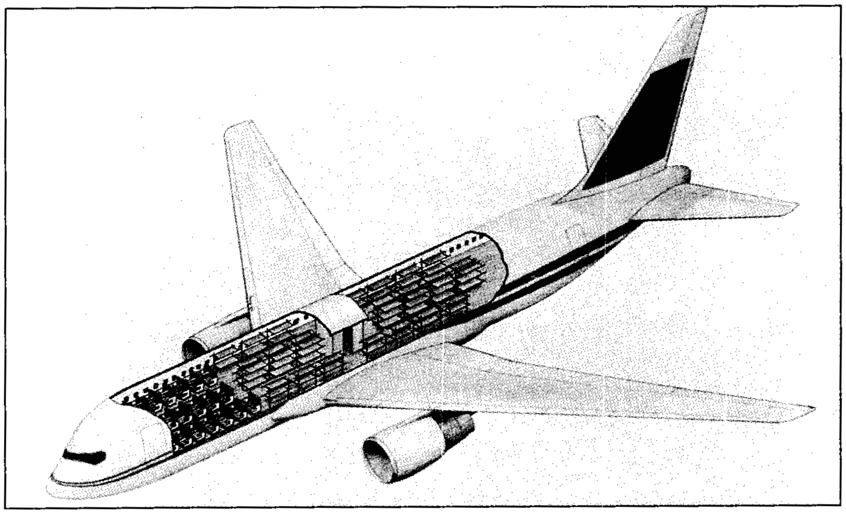
In addition, the AMD's role as the Air Force's human-centered advocate was strengthened with the assignment of the Air Force Human Resources Laboratory to Brooks in 1983. This Laboratory was the principle Air Force organization charged with the sciences and technology for choosing, preparing, and placing people at the heart of Air Force weapons systems and combat capability. Its mission maximized Air Force effectiveness through research and development to enhance the selection, classification, assignment, evaluation and effectiveness of training planning, design, delivery, evaluation, and management; and provided simulators and training devices to improve the effectiveness of aircrews and maintenance personnel.

The Laboratory was incorporated with the belief that the Air Force laboratories could more rapidly translate scientific discoveries and technical innovations into engineering solutions and weapons enhancement. The Aerospace Medical Division at Brooks Air Force Base became the free world's largest concentration of human, life and behavorial science personnel.

By the early 1980s there was a need to develop beyond exploratory research and provide the full spectrum for acquisition of human-centered technologies. Thus an Acquisition Office was developed to act as a bridge between laboratory technology and weapon systems production. By the end of the decade, acquisition mushroomed into 200-plus organizations responsible for advanced development, full-scale engineering development, and procurement of Life Support Systems, Chemical Warfare Defense Systems and other related systems.

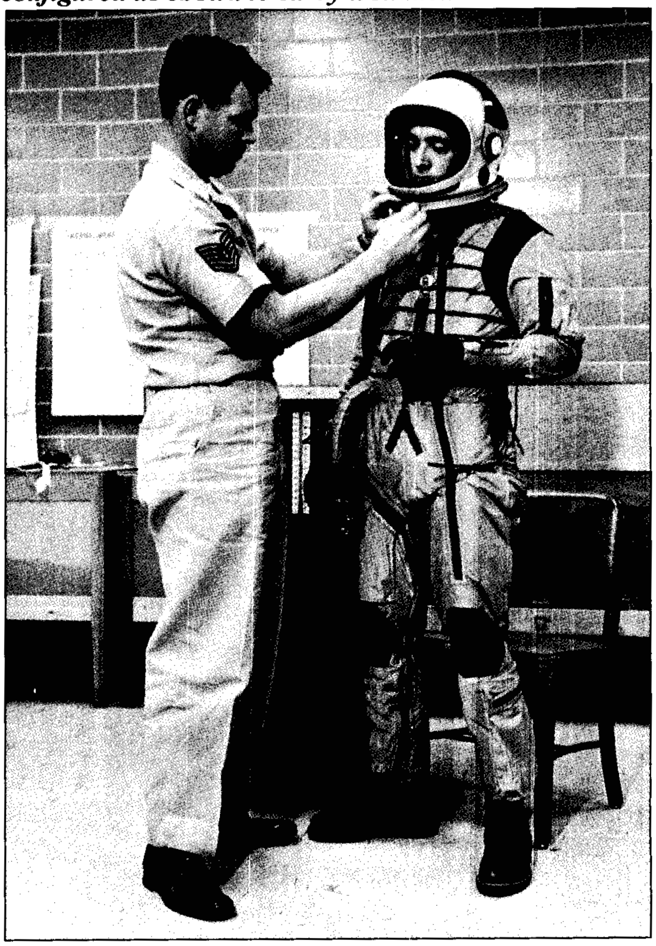
To emphasize the importance of its acquisition identity in meeting the human challenges of weapon systems development and operational support, the Aerospace Medical Division changed its name to the Human Systems Division (HSD) in 1987. The same logic was used to realign the program management for the Life Support System Program Office the following year. The System Program Office's realignment emphasized the importance of human systems advocacy, independent of weapons systems. It also gave the Human Systems Division at Brooks Air Force Base a new and significant status.

Systems Developed & Tested At Brooks

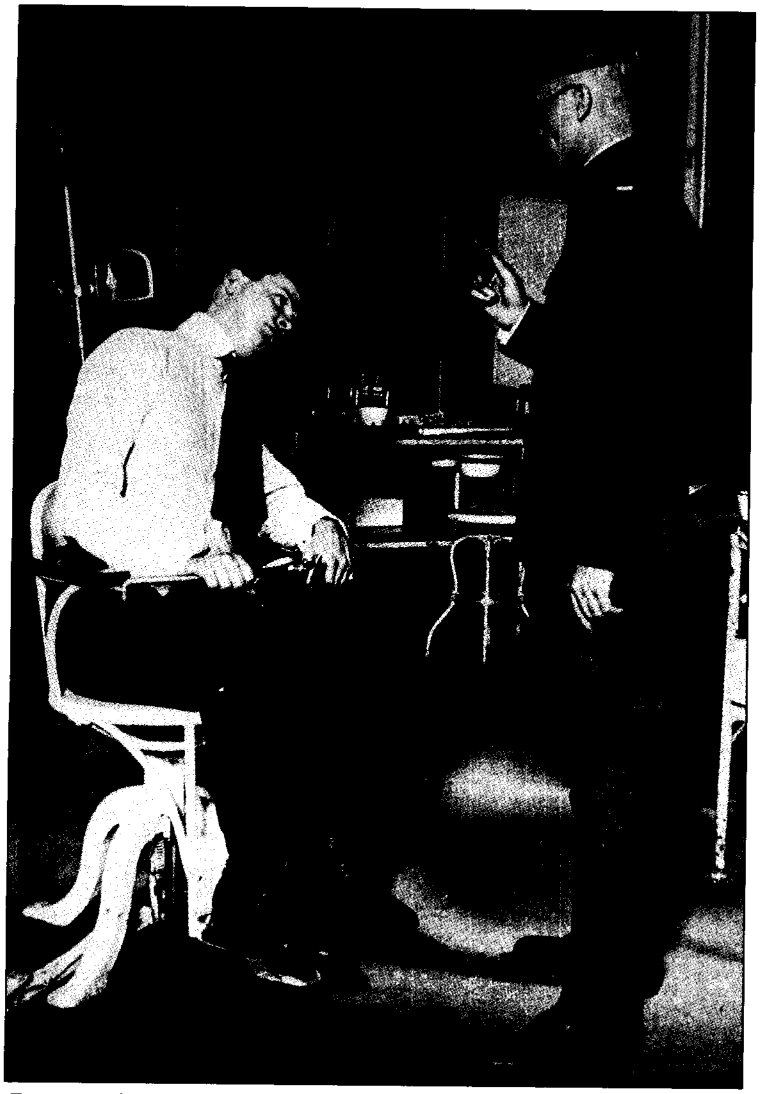


Civil Reserve Air Fleet - In times of war, civilian 767-200 or 767-300 aircraft would be configured as shown to carry wounded.

Early helmet-mounted Heads Up Display (HUD)

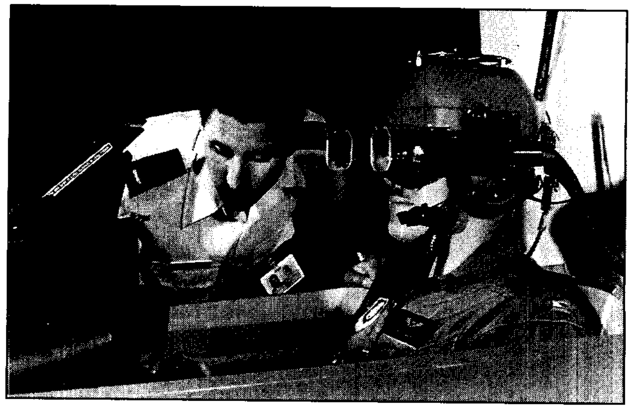


Early pressure suit developed at Brooks.

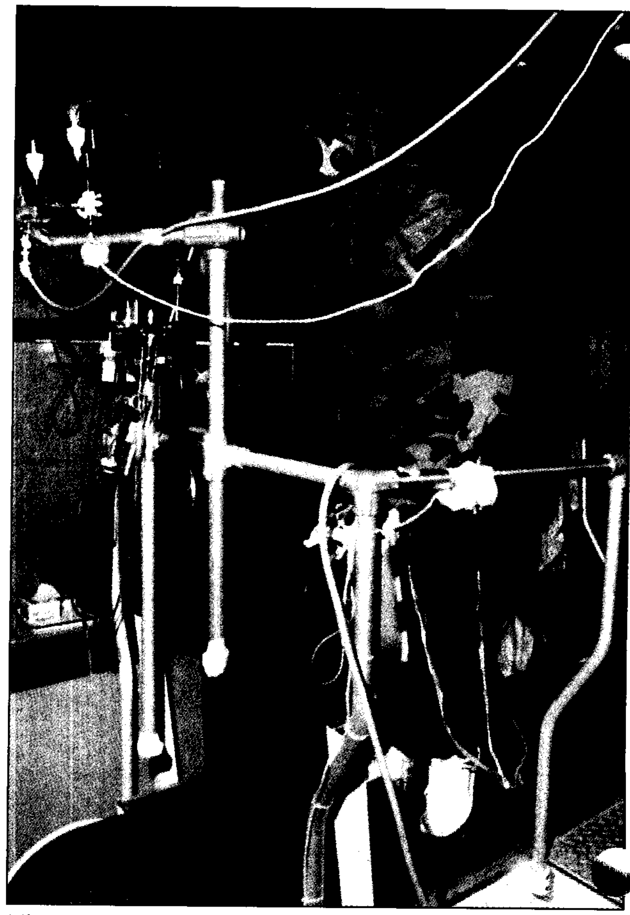


Barany Chair used in early aviation medicine to test pilots orientation ability.

BROOKS AIR FORCE BASE
75
1917 - 1992

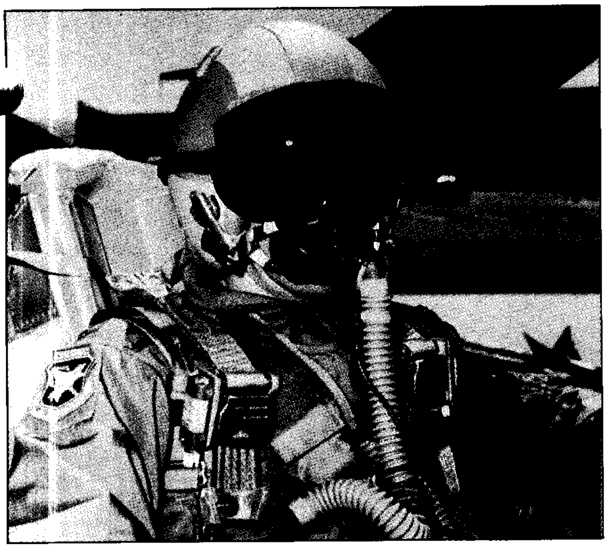


Laser Sight Designator

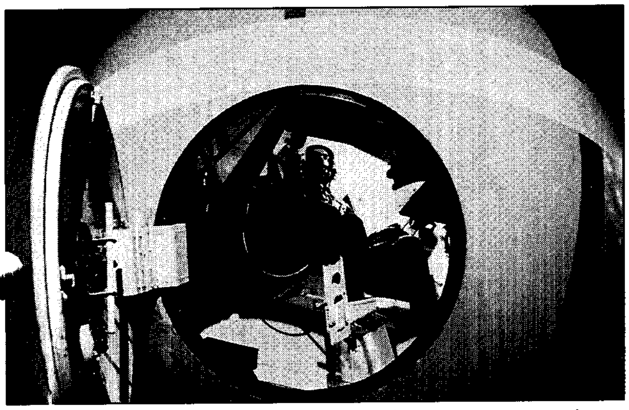


Chemical Defense Don-Doff Trials - testing how quickly you can put on and take off chemical defense gear when contaminated.

Thermal testing of Chemical Defense Gear



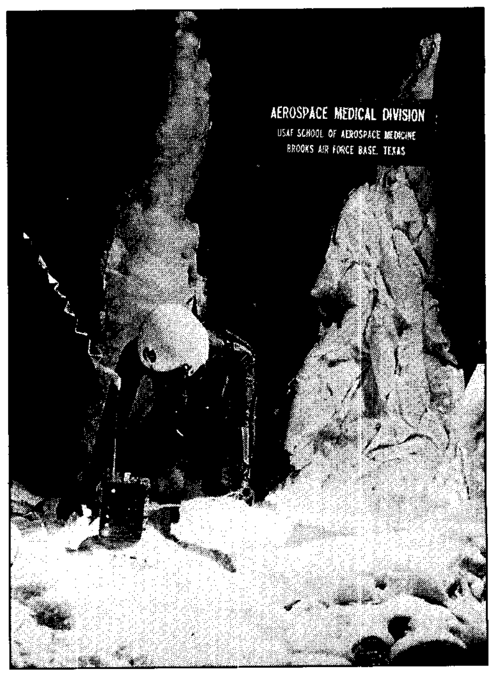
Combat Edge - Positive Pressure (Forced Air) Breathing Vest designed specifically for pilots of high performance aircraft.



Rotational Simulator used in early astronaut training. The simulator is on display in Hangar 9.

Tactical Aircraft Eye Respiratory System (TAERS)

Automatic/Self-deployed Water Survival Gear



Cold Weather Survival Training

Consolidations, War&New Challenges

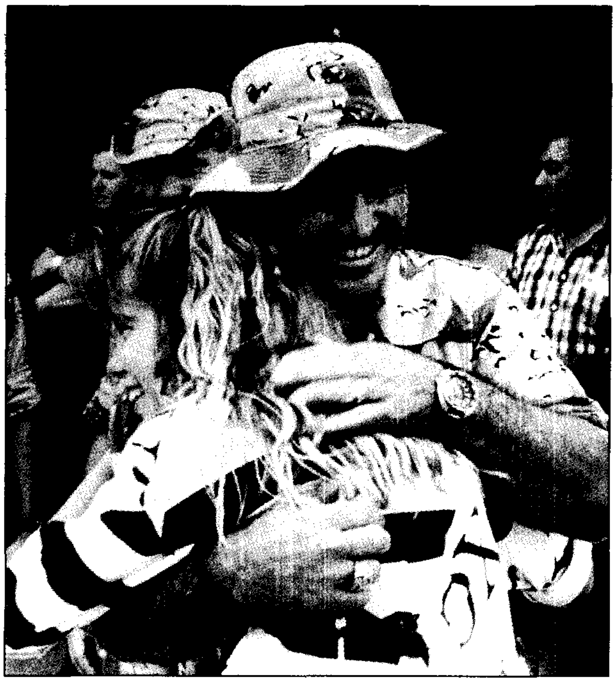
The 1990s ushered in a whole new era. For several years the Department of Defense (DoD) had been looking for better, leaner, smarter and more cost-saving ways to do business. However, this process was intensified with the unexpected collapse of communism in Eastern Europe and the demise of the Russian empire. Americans expected a peace dividend, believing the size and cost of the DoD should be reduced. Ironically, as downsizing became the buzz word, Brooks Air Force Base grew – one of four Air Force Super Laboratories, the Armstrong Laboratory, was formed at Brooks. It incorporated four complete labs, the Air Force Human Resources Laboratory, the Air Force Drug Testing Laboratory, the Harry G. Armstrong Aerospace Medical Research Laboratory, and the Air Force Occupational and Environmental Health Laboratory, as well as the laboratory function of the USAF School of Aerospace Medicine.

The Air Force Center for Environmental Excellence (AFCEE) also was formed and located at Brooks. This organization has the monumental task of restoring closed installations to their original state and of ensuring that future installations are environmentally safe.

Desert Shield/Storm

On August 2, 1990 troops from Iraq invaded neighboring Kuwait in an attempt to annex the oil-rich country. The United States and a coalition of 27 other countries sent in troops that eventually numbered 685,000. When diplomacy failed, action began on January 16, 1991. The war was over the following month, but not before the vast superiority of USAF technology was displayed to the world.

The Brooks war effort was expressed in several ways. A major Air Force goal during Desert Storm was to minimize noncombatant casualties. The U.S. Central Command asked the Human Systems Division to estimate the number of possible noncombatant casualties following attacks on certain military targets. Along with contractors, Brooks personnel developed a study of specific weapons, tactics, delivery platforms, rules of engagement and casualties.



TSgt. Fred Bedson, team leader for the 6570 Security Police Team on deployment day in support of Desert Shield.

USAFSAM's Department of Aerospace Nursing made significant contributions by recognizing the need for specific kinds of training prior to actual war involvement.

Brooks sent two groups of flight surgeons and one decontamination team to provide medical support in this Middle East conflict. Additionally, a full security police team was dispatched along with two personnel from the Occupational and Environmental Health Directorate of the Armstrong Laboratory. Brooks was prepared to aid the war effort with a Multi-Man Intermittent Cooling System, various aspects of chemical warfare defense protection, laser eye protection, pilot fatigue studies and other related needs of personnel in combat.

Desert Storm gave the Air Force the opportunity to take technology off the shelf, rush it into production and provide for the immediate needs of troops in Saudi Arabia. The Air Force had a need, and the Brooks Air Force Base team responded.

Koritz Memorial

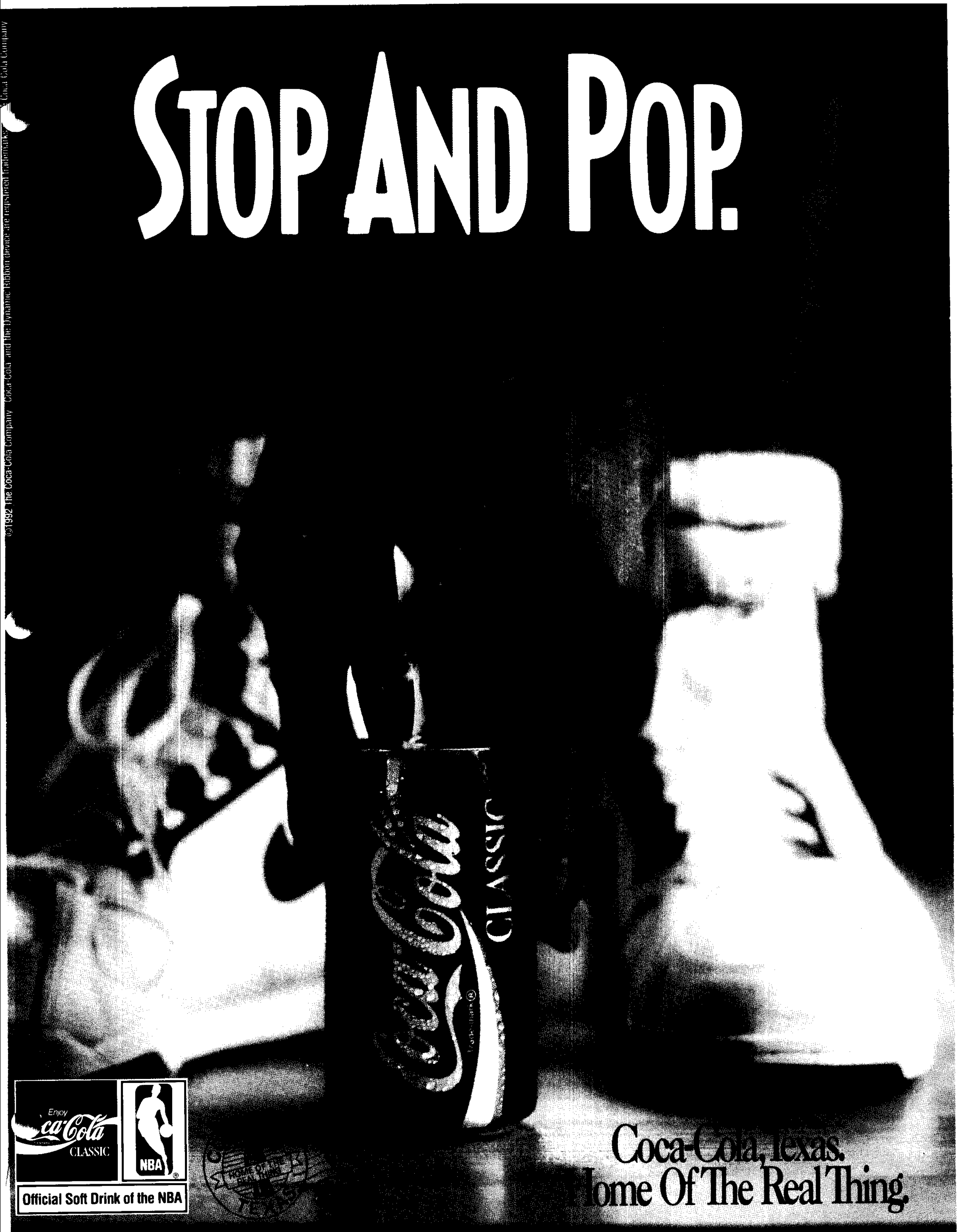
Koritz Memorial Garden is located at the entrance of building 180, Kilday Hall. The garden is dedicated to Major Thomas F. Koritz, Resident in Aerospace Medicine from 1987-1989. Major Koritz was killed in action near Basra, Iraq on January 17, 1992 while piloting an F-15E.

The Future

Consolidations continued in 1992 with the merging of the Air Force Systems command and the Air Force Logistics Command into a new organization called the Air Force Materiel Command (AFMC). As part of the new Command, the Human Systems Division at Brooks again changed its name to the Human Systems Center (HSC). Although the Air Force will be smaller, it will be flexible enough to respond, on short notice, to a wide range of regional crises and contingencies. According to AFMC's first commander, General Ronald W. Yates, "We are a new command with a new culture, stronger than ever, and postured to help Air Force war fighters deliver global reach, global power."

Without doubt, Brooks Air Force Base will remain an important part of that new culture, and as it has for the past 75 years, will continue to serve the needs of Air Force personnel worldwide. Brooks Air Force Base is looking to the future and is ready to meet all challenges.

This Commemorative Magazine is published by the Brooks Heritage Foundation, a private non-profit organization whose purpose is to preserve the heritage of Brooks AFB. The opinions expressed are not necessarily those of the Department of the Air Force or the Department of Defense.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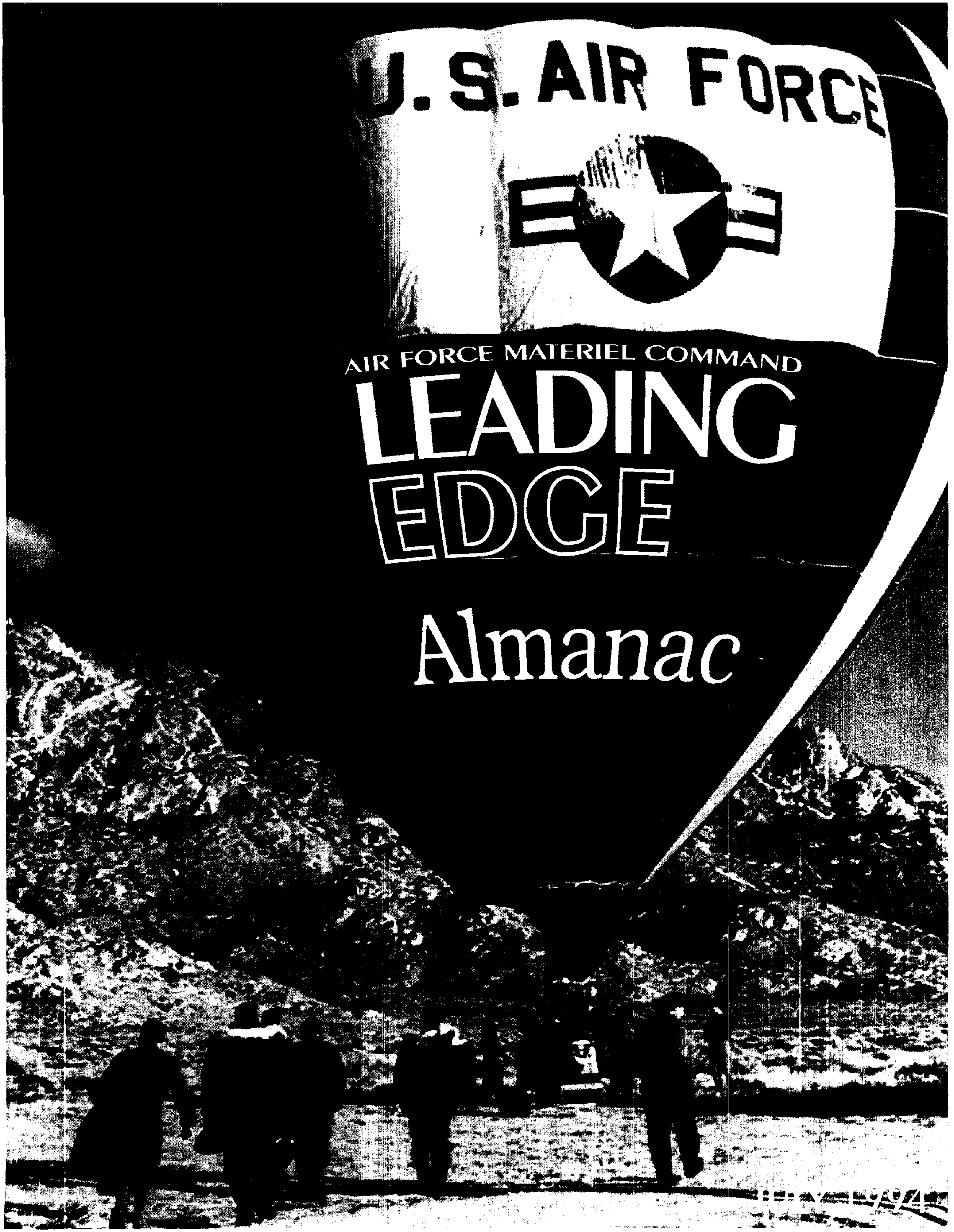

AIR FORCE MATERIEL COMMAND

LEADING EDGE

Almanac

JULY 1994

Contents

On the cover -- The Air Force's only hot air balloon, assigned to the 54th Test Group, Hill AFB, Utah, prepares for lift off. The balloon provides a stable platform for measuring air quality around industrial sites and examining the atmospheric effects on laser propagation. (Photo by Chris Bojanower)

AIR FORCE MATERIEL COMMAND

LEADING EDGE

Wright-Patterson Air Force Base, OH

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TOWARD NEW HORIZONS

Mission element boards and strategic planning enable AFMC to adapt itself to a changing Air Force, while still maintaining the command's high standards of excellence

In today's world of rapid change, Air Force Materiel Command looks ahead and plans for the future. Strategic planning is the process we use to assess the future and guide the command toward performing our mission as part of the Air Force vision.

Our AFMC mission, goals, and command objectives are products of our strategic planning process. They define where we are going and how we will get there. Metrics measure our progress toward our goals and objectives. We focus on managing by process and use metrics to help us continually improve the quality of our processes.

Planning ahead

Strategic planning takes place at various levels in AFMC. At the top level, command planning sets the broad direction for AFMC. This is where senior leaders from the field and the headquarters develop mission statements, goals, command objectives and command metrics. The principle forum for command planning is at regular HORIZONS meetings of senior leaders.

Below the command level, the AFMC mission is addressed in segments called mission elements. Mission elements represent the major things AFMC does for its customers — product management, support & industrial operations, science & technology, base operating support, and test & evaluation.

Setting the course

Each mission element has a corporate board that sets the direction for that segment of the mission. These boards identify objectives that support the achievement of the broader AFMC command objectives. The boards develop action plans detailing how objectives will be achieved and metrics measuring continuous progress toward these objectives. Each board reports to the senior leadership of AFMC at HORIZONS.

Finally, each field command and headquarters function develops objectives and specific action plans that focus their organization toward accomplishing the objectives of the mission elements. They also develop metrics to track their progress.

An integrated team

Taken together, the mission elements, field commands and headquarters functions constitute the AFMC Command Management Framework. Linking the framework together is the hierarchy of goals, objectives, and metrics that help make sure everyone in AFMC, at all levels, is doing his or her part, as the team moves toward the command goals.

The results of the strategic planning process are captured in the AFMC Strategic Plan. This is a living document, updated as necessary, that reflects the overall direction of the command and mission elements. Accomplishments against that plan are reported at HORIZONS by the mission element boards.

The principles of Quality Air Force drive the command's strategic planning, as they drive everything we do. They include clear direction; focus on our customers and suppliers; continuous improvement; and measurement. All are vital to our future.

Many tools are being used to guide us toward continuous improvement. The Quality Air Force assessment criteria are one tool we use to create a road map for future quality improvement. Others, such as benchmarking and the theory of constraints, also show great promise for helping us improve.

Air Force Materiel Command

One Team, One Mission

Air Force Materiel Command is an integrated team delivering and sustaining the best products for the world's best Air Force. AFMC researches, develops, tests, acquires, delivers and logistically supports every Air Force weapon system.

Five goals

AFMC builds a better Air Force by achieving five goals. The goals are:

1. Satisfy our customers' needs -- in war and peace.

2. Enable our people to excel.

3. Sustain technological superiority.

4. Enhance the excellence of our business practices.

5. Operate quality installations.

Cradle-to-grave process

The command, formally activated July 1, 1992, works closely with its customers to ensure each has the most capable aircraft, missiles and support equipment possible.

The cornerstone of this customer support commitment is a "cradle-to-grave" philosophy known as Integrated Weapon System Management.

AFMC Mission

Through integrated management of research, development, test, acquisition, and support, we advance and use technology to acquire and sustain superior systems in partnership with our customers and our suppliers.

We perform continuous product and process improvement throughout the life cycle.

As an integral part of the Air Force war fighting team, we contribute to affordable combat superiority, readiness and sustainability.

AFMC is the principal organization responsible for managing every aspect of a weapon system, from its inception on the drawing board, support throughout its operational life and to its final disposition.

Headquarters

The command's headquarters is at Wright-Patterson AFB, Ohio, where AFMC directs a highly professional and skilled work force of some 118,500 military and civilian employees, including most of the Air Force's scientists and engineers.

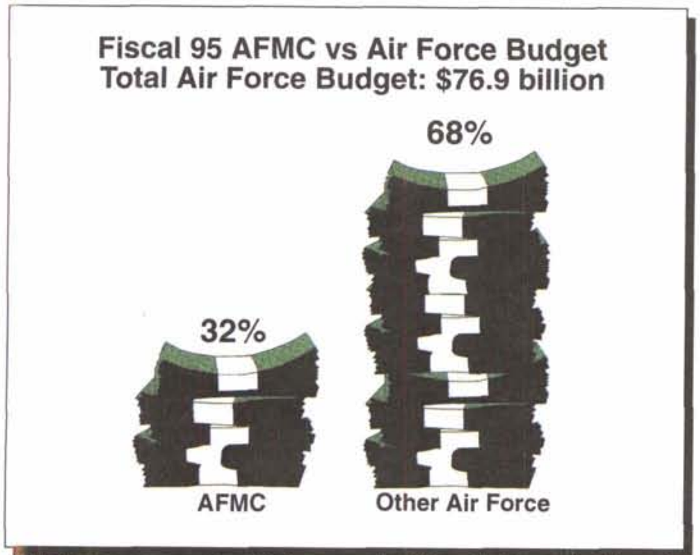
This work force operates major product centers, logistics centers, test centers and laboratories. The command's budget represents slightly more than 30 percent of the total Air Force budget.

Defense support

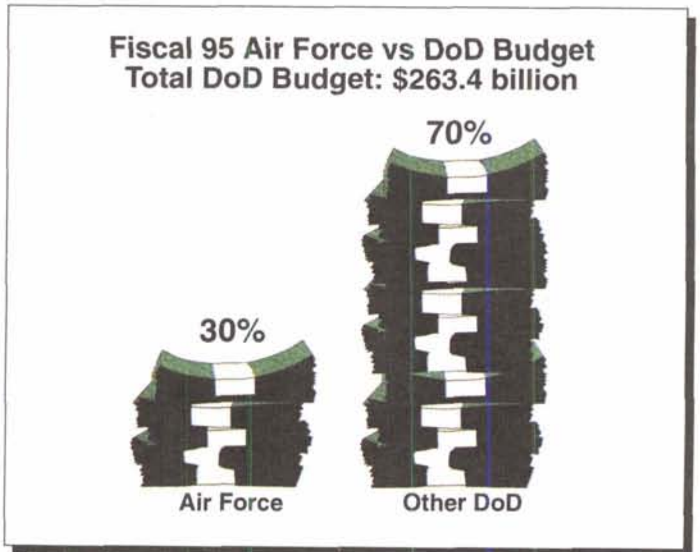
Also, AFMC provides support to other U.S. military forces and allies as well as handles major aerospace responsibilities for the Department of Defense.

These include research, development, testing and evaluation of satellites, boosters, space probes and associated systems needed to support specific NASA projects.

The Command



AFMC manages about 32 percent of the Air Force budget. Its budget of $34.7 billion includes $11 billion in Business Operating Funds that will be administered on behalf of the operational commands. In addition, AFMC manages nearly $100 billion in open Foreign Military Sales cases.



From the fiscal 1995 president's budget as total obligation authority.

Emphasizing quality

As U.S. military forces continue to draw down in size and defense dollars become leaner, AFMC emphasizes quality in every aspect of its day-to-day business. By instilling Quality Air Force principles in every process, AFMC works to ensure the Air Force receives the best quality products and services for every dollar spent.

Heritage

AFMC traces its heritage to 1917 when the Equipment Division of the U.S. Army Signal Corps established a headquarters for its new Airplane Engineering Department at McCook Field, a World War I experimental engineering facility in Dayton, Ohio.

Following the creation of the U.S. Air Service in 1918, the organization became known as the Engineering Division, a designation it retained until the Air Service became the U.S. Army Air Corps in 1926.

Largest Air Corps branch

In October 1926, the mission of the Engineering Division was expanded to include responsibility for the Air Corps logistics system, formerly vested in the Supply Division, and the organization was redesignated the Air Corps Materiel Division. As the largest branch of the Air Corps, the Materiel Division was responsible for all aircraft and equipment research, development, procurement, maintenance, supply and flight test.

Functionally divided again during World War II, research and development and logistics were reunited for several years during the late 1940s under Air Materiel Command. In 1950, the Air Research and Development Command was broken out as a separate organization devoted strictly to research and development.

In 1961, Air Materiel Command was redesignated Air Force Logistics Command, while Air Research and Development Command, gaining responsibility for weapon system acquisition, was redesignated Air Force Systems Command.

In January 1991, the secretary of the Air Force announced the planned merger of AFLC and AFSC. The new command would be known as Air Force Materiel Command.

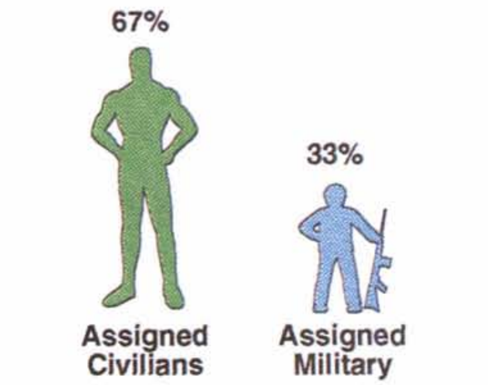
"World class" organization

AFLC's expertise in providing worldwide logistics support, including maintenance, modification and overhaul of weapon systems, combined with AFSC's expertise in science, technology, research, development and testing make Materiel Command a world-class organization.

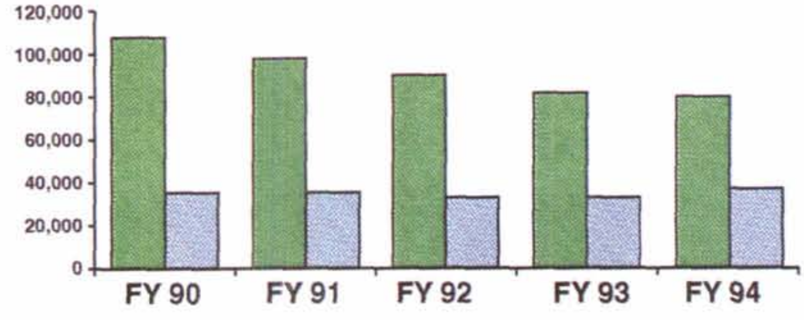
The two commands were dissolved, and Air Force Materiel Command was activated on July 1, 1992.

Demographics

AFMC Assigned Personnel as of June 1994



AFMC Manpower Authorizations as of June 1994



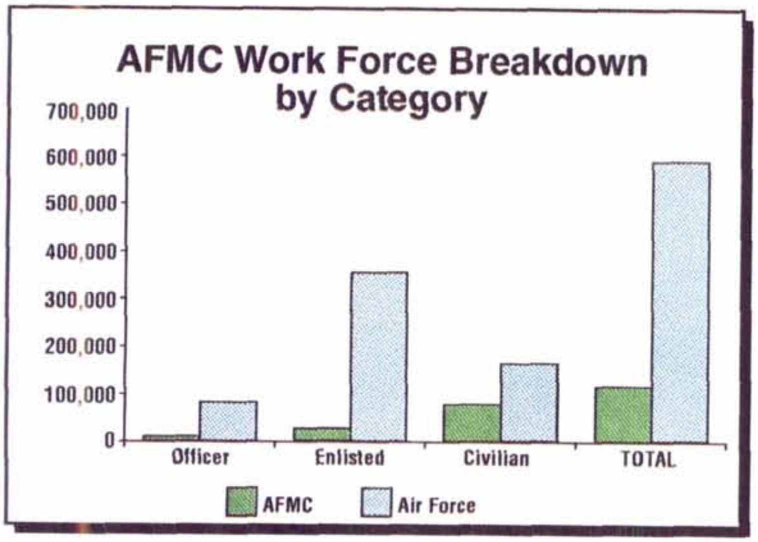
AFMC	FY 90	FY 91	FY92	FY 93	FY 94
Civilian	107,626	98,148	89,878	82,110	80,520
Military	34,937	34,745	32,912	32,698	35,672

AFMC Assigned Personnel at Major Units as of June 1994

Some Major Units*	Headquarters Location	Military	Civilians	Total
Aeronautical Systems Center	Wright-Patterson AFB OH	5793	9738	15531
Electronic Systems Center	Hanscom AFB MA	5487	5001	10488
Human Systems Center	Brooks AFB TX	1781	1352	3133
Space and Missile Systems Center	Los Angeles AFB CA	4552	3708	8260
Air Force Development Test Center	Eglin AFB FL	4789	2999	7888
Air Force Flight Test Center	Edwards AFB CA	4238	3175	8159
Arnold Engineering Development Center	Arnold AFB TN	127	197	324
Oklahoma City Air Logistics Center	Tinker AFB OK	1851	10443	12294
Ogden Air Logistics Center Center	Hill AFB UT	2109	8454	10563
Sacramento Air Logistics Center	McClellan AFB CA	2153	8886	11039
San Antonio Air Logistics Center	Kelly AFB TX	1726	10632	12358
Warner Robins Air Logistics Center	Robins AFB GA	1668	10402	12070

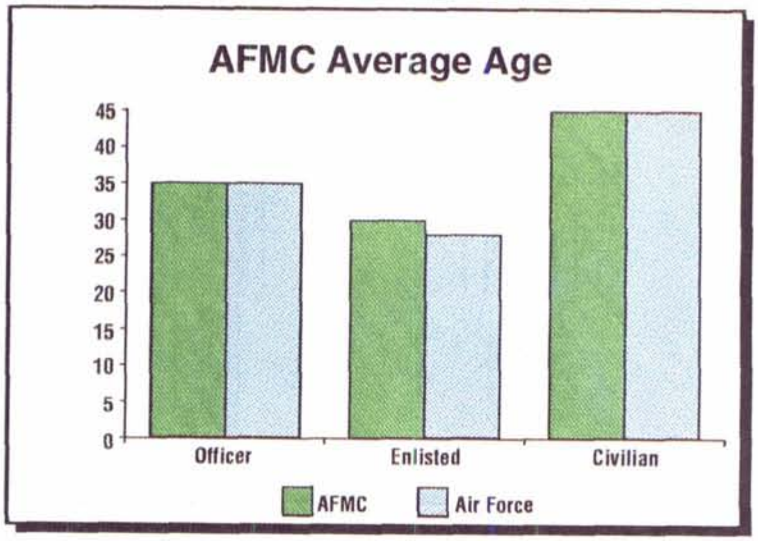
** All AFMC units are not shown in this chart. For example, the Air Force Office of Scientific Research, Bolling AFB, D.C., is not shown and neither is the Aerospace Guidance & Metrology Center, Newark AFB, Ohio. Also, many of the centers shown have geographically separated units whose personnel figures are rolled into the overall center figure. For example, personnel at the 377th Air Base Wing and Phillips Laboratory at Kirtland AFB, N.M., are rolled into the overall figure for Space and Missile Systems Center, Los Angeles AFB, Calif.*

Demographics



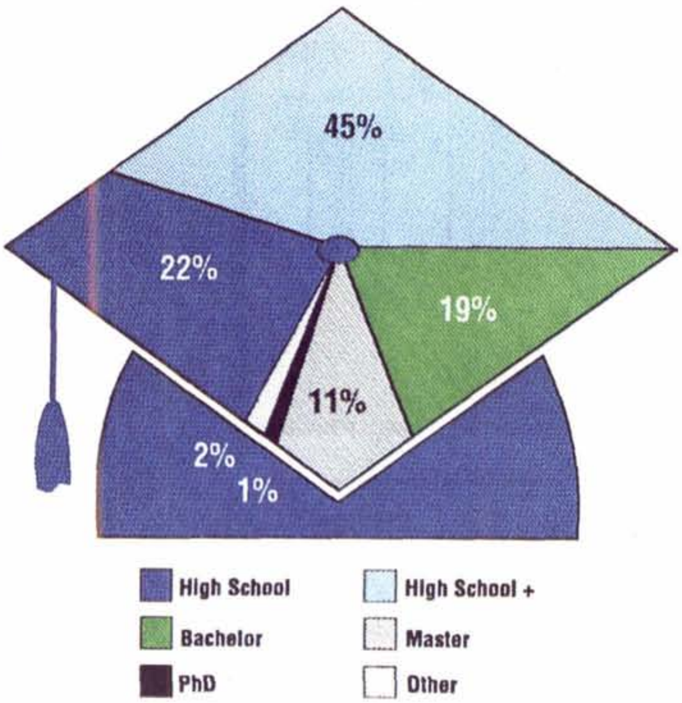
Work Force	Officer	Enlisted	Civilian	TOTAL
AFMC	11,788	26,773	79,951	118,512
Air Force*	81,000	350,000	163,792	594,792

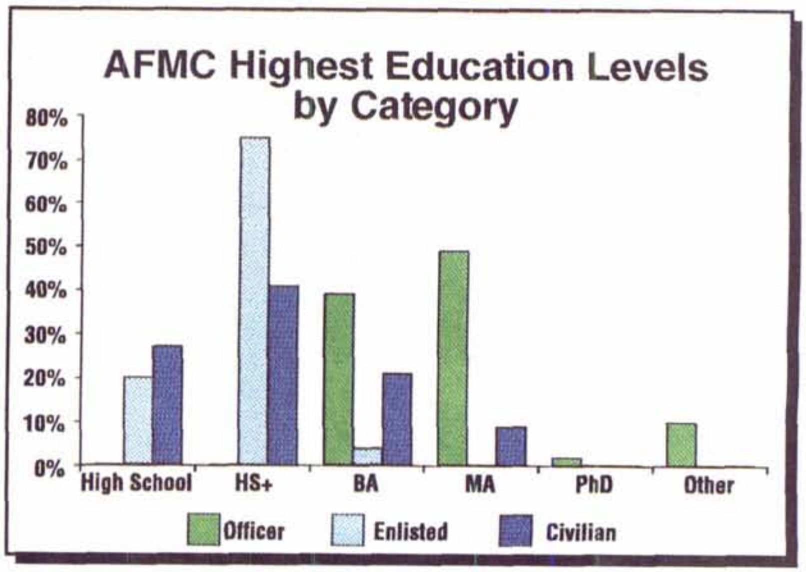
* As of March 31, 1994



Average Age	Officer	Enlisted	Civilian
AFMC	35.0	30.0	44.6
Air Force	35.0	29.0	45.0

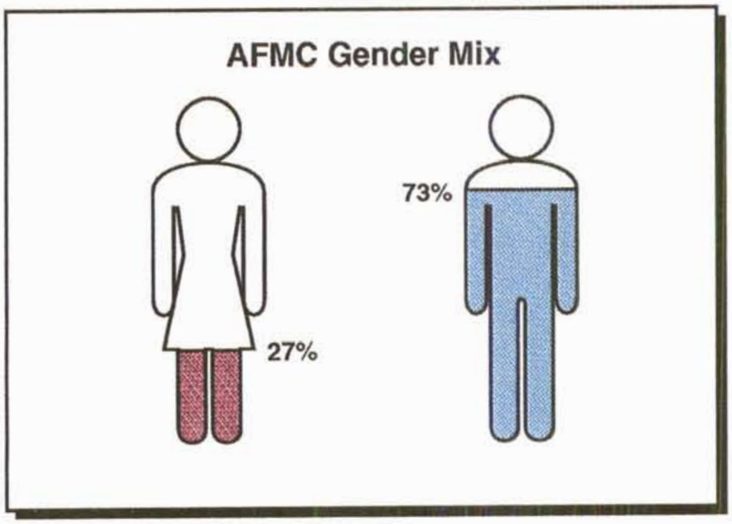
AFMC Highest Education Levels

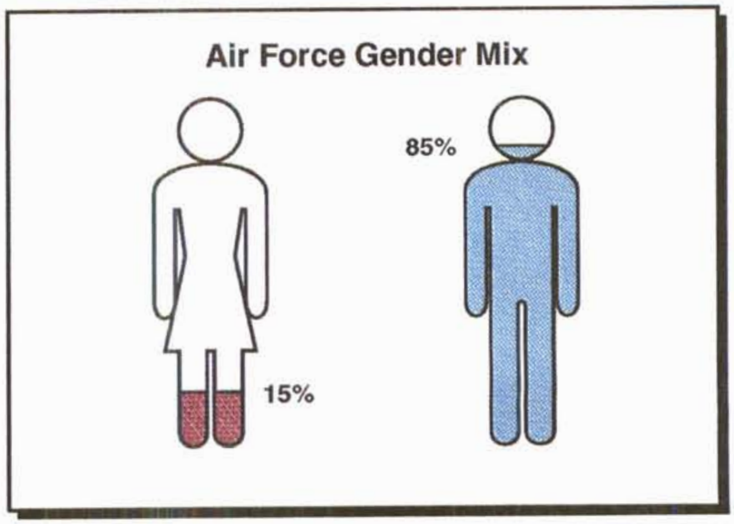


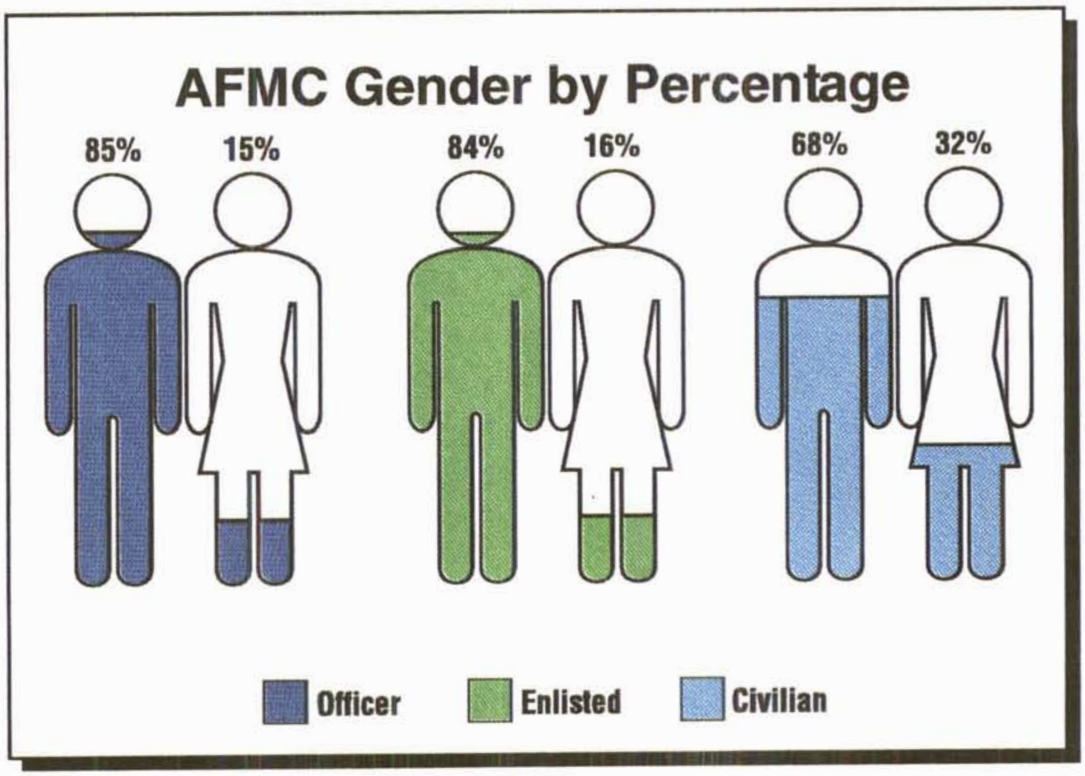


Work Force	High School	High School +	Bachelor	Master	PhD	Other
Officer	0%	0%	38.5%	48.8%	2.0%	10.0%
Enlisted	20.0%	75.0%	4.0%	0%	0%	0%
Civilian	27.0%	41.0%	21.0%	9.0%	0.1%	0.2%

Demographics







Gender	Officer	Enlisted	Civilian
Male	10,011	22,478	54,259
Female	1,777	4,295	25,692

Mission Element Boards

are changing the way Air Force Materiel Command does business. Keeping Air Force and command goals in sight, MEBs establish plans, review progress and make sure everything AFMC does supports its mission and customers.

Dwindling resources and an ever-shrinking work force have become a daily reality for Air Force Materiel Command. It's no longer enough to just "do more with less." The command, from the highest level of management to the lowest-grade employee, must work smarter than ever before and make sure precious resources are used for the right reasons.

To accomplish this task requires a clear understanding of what is — and is not — important to the organization and the customers it serves. Mission element boards help keep the command on track by providing the necessary corporate perspective and unifying the command's management strategy.

Five mission element boards

Mission element boards are composed of people from across the command, reaching farther down into AFMC to get ideas and opinions for policies and initiatives.

Each board focuses on one of five mission elements: Product Management, Support and Industrial Operations, Science and Technology, Test and Evaluation, and Base Operating Support.

Making plans, checking progress

Boards establish plans and constantly review progress to make sure their elements are supporting the command's mission, goals and objectives. Corporate review is done by the command board at the quarterly HORIZONS meetings.

Mission element boards are changing the way AFMC does business. By taking an integrated point of view, these boards are helping the command remain flexible and become more responsive to customer needs. At the same time, the MEB approach helps the command make more effective use of the resources it has today while planning for tomorrow.

Base Operating Support

The Base Operating Support Mission Element Board is an integrated team of field and headquarters functional leaders responsible for overseeing and guiding the delivery of base support.

This support takes the form of services, operations and processes involving facility infrastructure: vehicles and supplies; computers and communications; legal, financial, budget, and information management; operational contracting; history and public affairs; military and civilian personnel, career development, and education and training, safety and security; child development centers; on- and off-base housing and dormitories; environmental management; and religious, recreation, and leisure time activities.

"Stakeholders" are integral part of philosophy

Fundamental to the BOS MEB philosophy is the notion of "stakeholder" involvement. Stakeholders are viewed as everyone who spends BOS dollars, or directly or indirectly receives the benefits derived from actions of the BOS mission element. This causes BOS to examine its services and support from the perspective of economy, efficiency, quality and customer satisfaction. Competitiveness and cost efficiency are important—but, so too are proper customer service levels, motivated employees, and "good-citizen" status in the communities in which AFMC resides.

Dual contribution

The BOS Mission Element's contribution to the command is twofold. First, it supports each of the other mission elements. It must be responsive to the direction of AFMC as a whole. As such, it must support and facilitate necessary changes in AFMC caused by the environments in which the command operates.

Second, it is responsible for delivering its own products and services. That is, in addition to supporting the mission of the command and the other mission elements, BOS products and services directly impact the living and working environments of the people performing that mission and contribute to their quality of life. Sound base operating support is a necessary condition for the success of the other mission elements, the quality of AFMC installations, and the productivity of its people.

Three elements for effectiveness

The BOS MEB operating procedures have three elements designed to optimize its effectiveness. The first is to assess progress in supporting command mission, goals and objectives by reviewing action plans and metrics. The second is to develop continuous improvement strategies that improve service and product delivery to AFMC customers. This same approach is used to assess and improve suppliers of goods and services to the various functional areas that constitute base operating support. The third is to revise, delete or add supporting objectives, actions plans and metrics as the need for updating becomes apparent. Together, the three support the MEB strategic plan.

Since it was established, the BOS MEB has had both ownership and supporting roles in many of the command's goals and objectives. For example, BOS is the primary mission element that provides for human resources development—or put another way, ensuring our people have the knowledge, skills and abilities to accomplish the mission. Additionally, BOS provides the overall direction, planning and execution of AFMC's environmental pollution prevention, compliance and restoration programs.

Improvement is the goal

BOS also aims to improve AFMC's facilities, infrastructure and services, along with the working and living environments for all the command's people. This is a tough task in times of declining resources — but the MEB attacks the issues by using priorities and targeting the limited funding to those needs that will yield the highest impact in all these areas.

BOS, along with all the other mission elements, also focuses on improving the quality and reducing the cost of our products and services. About 20 separate metrics show both the cost efficiency and quality aspects of BOS goods and services — the "BOS DOW Jones" average of product and services. Additionally, the MEB directs efforts toward commitment to the customers — making them and meeting them. The key to success is continuous interaction with the customer, before, during and after services are delivered.

Playing a big role

Finally, we play a big role in the ability of AFMC to meet deployment, wartime support and base sustainment requirements. BOS active military and reserve individual mobilization augmentees play an important and continual support role in contingency situations worldwide.

The BOS MEB's philosophy embraces its mission: "Provide excellence in support operations and services..." Stakeholder involvement, thorough assessments of mission element support as well as the direct services it provides its customers, and continuous updating of MEB measurement tools, are the foundations of its success.

Science & Technology

Technological superiority is the cornerstone of the Air Force's war fighting capability. Maintaining that edge into the future is the responsibility of the Air Force science and technology program and forms the basis for AFMC's Goal 3: Sustain Technological Superiority.

To achieve that goal, the Science and Technology Mission Element Board provides a forum for deliberating AFMC corporate issues relating to the Air Force S&T program.

Additionally, the S&T MEB functions within the framework of the AFMC strategic planning system and focuses on train/organize/equip issues, objectives, processes, and metrics in support of all aspects of the AFMC S&T mission element.

Integrated membership

Key board members include the director and deputy director of Headquarters AFMC Directorate of Science and Technology; directors of the command's four "super" labs, the Air Force Office of Scientific Research, and the Technology Transition Office. The headquarters director of Science and Technology also serves as the Air Force technology executive officer, or TEO.

Other core members include the assistant secretary of the Air Force for acquisition's director of Science and Technology; and, the Air Force chief scientist.

Chief scientists or technology directors for the air logistics centers; product center advanced planning directors; test center chief scientists; technical directors (or the equivalent) of the other command centers, as well as directors or representatives from HQ AFMC's two-letter functions, serve as associate members and provide important information relating to their areas of expertise.

Operating philosophy

Like its sister MEBs, the S&T board meets quarterly at various locations throughout the command to enhance information exchange and provide board members an opportunity to see the facilities, mission and related issues first hand.

Key on the meeting agenda is a review of the overall effectiveness of the Air Force S&T program. During these meetings, board members assess the quality of support the S&T MEB provides to the command's mission, goals, and objectives as they relate to science and technology issues.

Critical review

Based on this critical review, the board establishes and revises supporting objectives, action plans, and metrics to ensure AFMC's science and technology program remains productive and on track. The board will charter special groups to develop issues and/or options for consideration by the board at future meetings.

All proceeding are carefully recorded so no ideas, recommendations or action items are left out. The S&T MEB, like the others, report their progress to the command's senior leadership at the S&T HORIZONS on mission element planning and performance. Results from this forum are then documented in the AFMC Strategic Plan.

MEB Initiatives

The Technology Master Process provides an end-to-end process for technology development, transition, application/insertion, and transfer. It allows for a free flow of communication with all Air Force S&T customers through AFMC Center Technology Councils and Technical Planning Integrated Product Teams.

Under this concept, the MEB defined and documented the process, produced training videos for all the centers, and completed the first cycle of collecting information on their customer's needs. The customers then provided a list of prioritized needs, and the Air Force technology executive officer and the Technology Transition Office built dollar-constrained projects to meet those needs.

The Air Force Science and Technology Report, or AFSTAR, was developed to emphasize to the public the value of the Air Force S&T program. It also serves to focus the customers' attention on the importance of science and technology to their current and future operations.

Finally, the report provides opportunities for recognition to AFMC's science and technology superstars. To achieve AFSTAR's goal, a corporate AFSTAR budget was established and an AFSTAR integrated product team was formed. The IPT's main goal is to develop a strong and continuously improving AFSTAR program throughout AFMC to tell the Air Force science and technology story.

With this goal in mind, the IPT developed a standardized format and distribution for S&T success stories; and established criteria for and publicity of AFMC AFSTAR events.

Big emphasis on dual-use

The S&T MEB places a great deal of emphasis on developing dual-use technologies and transferring current technology to industry. In this arena, the MEB's objective is to promote dual-use technologies through research and development partnerships and cooperative agreements with industry, and by pursuing spin-off opportunities.

As a result of the focus on dual-use technologies and technology transfer:

• Cooperative R&D agreements in the AFMC labs and centers have increased by almost 200 percent in the last 15 months, from 45 to 123.

• The AFMC Technology Transition Office opened the technology information "hotline" in June 1993. Called the Technology Connections (TECH CONNECT) Team, this special line helps the commercial sector and other government agencies learn about potential technology transfer opportunities. The hotline has handled more than 600 requests over the past nine months.

Support and Industrial Operations

The Support and Industrial Operations Mission Element Board is responsible for the command activities that ensure the Air Force operating commands get the best support at the least cost for every system AFMC delivers.

S&IO's members come mainly from the logistics community, but also draws from a core of functional experts from throughout the command.

The S&IO MEB emphasizes close interaction with the other four MEBs on issues that cut across mission elements. The S&IO focuses on continuous improvements to customer service.

The Department of Defense can no longer afford to maintain redundant depot capabilities. Budget cuts, downsizing and the accompanying changes in defense strategies are the major challenges shaping S&IO philosophies. To meet those challenges, the board has sponsored a number of initiatives.

Lean logistics

In an environment of dwindling resources, the S&IO MEB is steering the Air Force toward Lean Logistics — an effort to improve customer support while reducing both the levels of spares in inventory and the repair/procurement pipelines for those items necessary to accomplish the mission.

In addition, S&IO is exploring ways for the major commands and the air logistics centers to work more closely together in deciding what to repair and how to distribute assets for better weapon system support. S&IO policies are designed to provide balanced weapon system support to Air Force systems, and to respond quickly to evolving Air Force priorities.

Two-level maintenance

All major weapons systems, and the depot processes to support them, were historically developed with a three-level maintenance concept — organizational, intermediate and depot.

However, faced with shrinking defense spending, the secretary of the Air Force and the Air Force chief of staff have directed a transition to a two-level maintenance concept.

Under the two-level concept, off-aircraft troubleshooting, repair and return to supply lines shifts from base-level shops to AFMC depots. If it can't be fixed on the aircraft, it's pulled and replaced, and the defective part is sent to the depot.

Such a concept will maximize the fighting force while also complying with congressionally mandated military end-strength reductions. It supports the Air Force's vision of global reach/global power, because it reduces the numbers of people and equipment operational commanders must take with them when they go to war.

Weapon system banding

In the past, AFMC didn't have an established process for allocating and spending Reparable Support Division/System Support Division "buy" obligation authority (OA) by weapon system when funding was significantly lower than the requirements.

To correct this and maximize the available OA, weapon systems were organized into six bands according to priority. Weapon systems within each band are funded to achieve a set percentage of their desired availability goal.

Using this system in times of low funding, items that are most critical to mission accomplishment can be given higher priority over other, not-so-critical items, therefore eliminating shortages that would adversely affect the mission.

Test and Evaluation

The Test and Evaluation Mission Element Board is the corporate leadership for AFMC's test community by providing guidance for T&E people who work in all phases of a weapon system's life cycle and manage the vast test infrastructure for all Air Force testers.

AFMC people in the T&E arena assist in test planning from the earliest program stages. This help can include overseeing testing performed by contractors, performing sub-system or full-system testing themselves, or working with the operational test community in a combined effort.

Once a system is fielded, developmental testing may be used again to evaluate system modifications.

The T&E MEB performs the strategic planning necessary to support these workers by contributing timely, accurate and affordable information to single managers and other decision makers to support system life-cycle decisions. This is done through disciplined application of the test management process while supporting AFMC's goals and objectives.

Strategic planning

A portion of each of the MEB's quarterly meetings is used for strategic planning. This planning can involve a detailed look at one or more steps in the test management process.

Progress is monitored through a set of metrics with the primary focus placed on the customer satisfaction trend. Special panels and teams evaluate sub-processes and proposed policy changes prior to an MEB vote.

The operations panel, whose membership includes the test wing and test group commanders, reviews test-execution organization inputs on policy, resources and infrastructure before these issues are submitted to the full board.

A technologies panel works with the command's laboratories to promote continued technology infusion into the test world.

Other teams are documenting test resources within the logistics centers and addressing cost reporting and cost reduction initiatives.

The T&E MEB has taken on many initiatives to improve communication within their mission element. The quarterly meetings are rotated throughout the command to allow people in the field to view and participate in MEB activities.

In addition, a field focal point network has been established to further facilitate T&E communications between headquarters and the field. Other initiatives include:

Test process

In conjunction with Air Force test and evaluation officials, the MEB is implementing a standardized test process across all mission areas.

This process is mandated through a new Air Force instruction and is supported by mission-area manuals. A standardized process will respond to test lessons learned by instituting greater discipline into the test function and ensuring best use of test resources.

Single face to the customer

Single Face to the Customer Offices have been opened for each of the five T&E mission areas: electronic combat, space, aircraft-propulsion-avionics, armament/munitions, and command, control, communications and intelligence. These offices serve as repositories of expert knowledge on the mission area's test processes, capabilities and resources.

The focus is on supporting acquisition/modification programs in the early planning stages with recommendations on test strategy and resource use.

In addition, the offices support focused resource planning through the development and maintenance of mission area investment road maps.

Test Investment Strategic Plan

Through the Test Investment Strategic Plan, the T&E MEB has documented long-range mission area, infrastructure investment strategies.

The plan captures the results of the test investment planning and programming process and documents the known shortfalls, resource solutions and priorities as well as implementation strategies.

Product Management

The Product Management Mission Element Board covers the full range of the single manager's responsibilities — cradle-to-grave product management. Product management activities deliver weapon systems to the warfighters and sustain them throughout their life cycle.

Striving for efficiency

The MEB strives to provide that capability in the most effective way by providing the best-value options to meet the warfighters' needs. The PM MEB provides the resources, tools and assistance to accomplish the single manager mission.

The MEB also develops or improves processes and tools for the command's product managers. The PM MEB is responsible for prioritizing its efforts and applying resources accordingly.

Two concepts

Two concepts, combined with participative management through the ballot process, are key to the PM MEB in using its resources to best advantage -- Integrated Weapon System Management, or IWSM, and Integrated Product Development or IPD.

IWSM is the AFMC management philosophy for acquiring, evolving, and sustaining the command's products. It empowers a single manager with authority over the widest range of decisions and resources to satisfy customer requirements throughout the life cycle of the product.

IPD is a philosophy that systematically employs a teaming of functional disciplines to integrate and concurrently apply all necessary processes to produce an effective and efficient product that not only satisfies the customer's needs, but also focuses on the processes that make the product possible.

The board also uses product management focal points and single managers' conferences as ways to ensure full participation of headquarters and field units and single managers in deciding which issues need priority attention. In addition to the MEB's regular meetings, the board uses the PD Infonet and the center commanders' XR Hotline for rapid communication of information on current issues.

The PM MEB is working on a number of initiatives to improve operations within the mission element.

Integrated Product Development

This initiative supports the command's objective to successfully institutionalize the Integrated Product Development philosophy in all present and future AFMC activities.

This objective will be achieved when decisions at all levels of the command hierarchy are consistently made through application of all eight tenets of IPD.

Progress toward achieving this objective is measured against the tasks in the command implementation plan and the action plans associated with each task. A self-assessment metric is used to track progress in applying the eight tenets of IPD in each team.

Pollution Prevention

The board is developing an Air Force strategy to comply with federal orders to eliminate use of ozone depleting chemicals, and reduce the use of hazardous material in the production and sustainment of weapon systems.

To accomplish this goal, the PM MEB is working with representatives from program executive offices, designated acquisition commanders, the Defense Logistics Agency, and the Joint Logistics Commanders to reduce duplication and solve common problems across systems to reduce cost.

They also are working with suppliers in industry to leverage their efforts across common processes to further reduce costs.

Progress is measured by a set of metrics that shows reductions in pounds, reduction in the use of ODCs and hazardous materials, and changes to governing technical orders for weapon systems.

The heart of Air Force Materiel Command's basic research efforts lies in its

Laboratories

AFMC promotes dual-use technologies research and development partnerships and cooperative agreements with industry. As of May, cooperative agreements in AFMC's labs and centers have increased from 45 to 123.

Armstrong Laboratory

Ensures the Air Force's weapon systems and the people operating them are compatible. It also provides a healthier environment for Air Force members.

Armstrong Laboratory, Brooks AFB, Texas, researches and develops technology for maintaining, protecting and enhancing human capabilities during Air Force operations.

An integral part of the Human Systems Center, at Brooks, the lab's programs concentrate on the human aspects of Air Force weapon systems.

The lab's products ensure people can perform well at all system levels: individual, crew, team and force. They also enable the Air Force to meet current and future operational needs in aerospace medicine; crew systems; human resources; occupational and environmental health; and environmental restoration.

An F-16 pilot, outfitted with COMBAT EDGE, prepares for departure on a high-G air-to-air mission. COMBAT EDGE employs positive pressure breathing technology, developed at Armstrong Lab, to provide aircrews additional protection against high positive accelerations experienced with today's modern fighter aircraft.

Six Mission Directorates

Plans and Programs reviews existing scientific and technological capabilities, and future system needs, ensuring customers state-of-the-art technology.

Aerospace Medicine applies medical principles to selecting, retaining and maintaining Air Force people.

Occupational and Environmental Health assesses risks to people from noise, hazardous material, electromagnetic radiation and various occupational processes in Air Force operations.

Crew Systems researches how human operators interact with weapon systems to optimize people's performance, protection and survivability in combat.

Human Resources researches and develops technologies to acquire, classify, train, integrate, and manage Air Force people for maximum combat effectiveness.

Environics develops low cost ways to resolve environmental problems and clean up existing facilities.

Just the facts...

❑ The lab sponsors and conducts research and development in such disciplines as: toxic hazards, aircrew medical standards, radiation and directed energy bioeffects, human engineering, crew protection and life support, and training devices and systems.

❑ Armstrong Laboratory is named after Maj. Gen. Harry G. Armstrong, first director of the Aeromedical Research Laboratory.

❑ In December 1990, the Armstrong "super" lab was combined from the Aeromedical Research Lab, the Air Force Human Resources Laboratory, the Air Force Drug Testing Laboratory, the Air Force Occupational and Environmental Health Laboratory and the Air Force School of Aerospace Medicine.

❑ Armstrong Lab does both in-house and contracted basic, exploratory and advanced development research in 88 facilities located in Texas, Arizona, Ohio, Florida and Okinawa.

❑ Armstrong Lab employs more than 1,000 people, with scientists and engineers making up more than half that number.

❑ A majority of the lab's scientists and engineers have advanced technical degrees with about one-third holding doctoral degrees.

❑ The lab wants to expand the diets of bacteria being used to break down fuel contamination in soil so they will also dine on other harmful substances.

Phillips Laboratory

The Air Force's single focal point for all space- and missile-related research and technology, including geophysics, propulsion, space vehicles, survivability, and directed-energy weapons.

Phillips Laboratory, Kirtland AFB, N.M., is part of AFMC's Space and Missile Systems Center, located at Los Angeles AFB, Calif.

Phillips Lab exploits technologies used to develop spacecraft, ballistic missiles, and directed-energy weapons. It integrates and transitions its research technology into military systems used by operational commands and maintained by AFMC.

Main organizations

Propulsion, Edwards AFB, Calif., focuses on advanced concepts involving motors, propellants and test techniques.

Geophysics, Hanscom AFB, Mass., explores the environment between the Earth and the sun, and its effects on systems and operations.

Space and Missiles Technology, Kirtland, focuses on spacecraft structures, power and thermal management, sensors, electronics and spacecraft technologies.

Lasers and Imaging, Kirtland, demonstrates the technical and engineering feasibility of lasers and imaging systems.

Advanced Weapons and Survivability, Kirtland, develops high-energy plasma and microwave technologies, electromagnetic pulse hardening, space systems survivability, and advanced techniques and computer simulations for weapon effects.

Space Experiments, Kirtland, plans, manages and conducts space experiments on the ground, from balloons, in aircraft and from space orbit.

The Airborn Laser System Program Office, Kirtland, develop an aircraft-based technology that will acquire, track, and kill theater ballistic missiles in the boost phase.

Starfire Optical Range's 3.5 meter telescope at Kirtland AFB, N.M., is the Department of Defense's biggest telescope. The range's primary mission is to perform field experiments and analyses on the effects of atmospheric turbulence upon propagating optical radiation. The telescope is located 6,200 feet above sea level.

Just the facts...

- **Phillips Lab's annual budget totals about $700 million.**
- **The laboratory's work force totals nearly 2,000 military and civilian employees at Kirtland AFB, N.M.; Hanscom AFB, Mass., and Edwards AFB, Calif.**
- **Phillips Lab scientists have developed a new technology for building large, thin, lightweight mirrors for space technologies. The technology also will be available for building astronomical space and ground telescopes.**
- **The Technology for Autonomous Survivability system, or TAOS, will allow future spacecraft to navigate on their own.**

This technology, developed by Phillips Lab, was launched from Vandenberg AFB, Calif., in March, and, if successful, could reduce satellite ground support costs for future systems.

Rome Laboratory

Air Force Materiel Command's center for Command, Control, Communications and Intelligence (C3I) research and development.

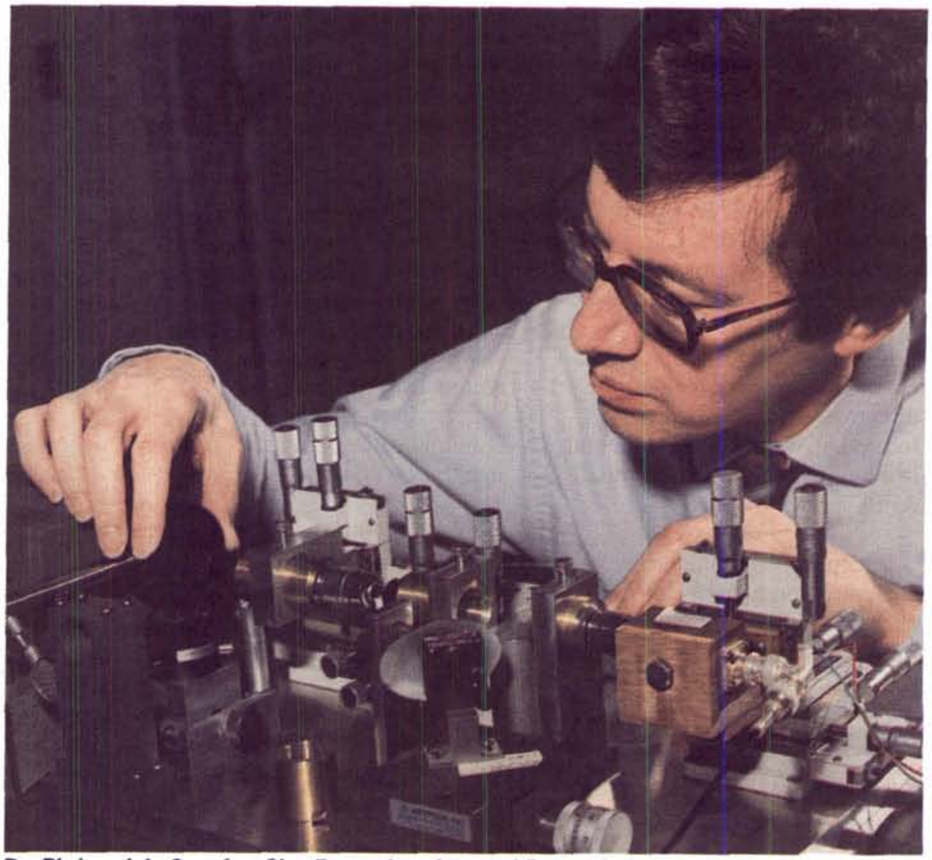
High quality surveillance, communications and information processing are critical to effectively plan, direct, coordinate and control U.S. forces worldwide.

Rome Laboratory, Griffiss AFB, N.Y., provides the Air Force with a more effective command, control, communications and intelligence capability by developing techniques and equipment for the surveillance of ground and aerospace objects, and for inter- and intra-theater communications.

The lab also leads development of technologies for battle management systems and intelligence data handling.

Other technologies pursued by the lab are: software engineering; artificial intelligence/expert systems; solid state sciences and materials; electromagnetics; photonics; signal processing; computer architectures; and the reliability, maintainability and compatibility of electronic systems.

Rome Lab is directly responsible to the Electronic Systems Center, Hanscom AFB, Mass., in technical areas.



Dr. Richard A. Soref, a Star Team leader and Rome Lab scientist at Hanscom AFB, Mass., sets up a silicon guided-wave device for measurements in optical components, a research area he pioneered and for which he received the Air Force Basic Research Award in 1991.

Just the facts...

❑ **Rome Lab operates four state-of-the-art technical directorates: three at Griffiss AFB, N.Y., and one at Hanscom AFB, Mass.**

It also operates off-base sites in New York and Massachusetts where research and engineering is conducted in surveillance, communications, antennas and scattering.

❑ **Rome Lab's work force totals about 1,000, with the majority specializing in electronics, physics, computer sciences and mathematics.**

❑ **Since 1951, Rome Lab people have developed the technology incorporated into systems such as the:**

- **Ballistic Missile Early Warning System**
- **Distant Early Warning Line**
- **Semi-Automated Ground Environment System**
- **Back-Up Interceptor Control System**
- **Over-the-Horizon Radar**
- **Joint STARS**
- **Airborne Warning and Control System.**

❑ **Its annual budget is more than $300 million, with ongoing contracts valued in excess of $1.4 billion.**

❑ **In August 1960, Rome Lab scientists were the first to transmit an intercontinental voice signal via satellite using the NASA Echo I balloon satellite.**

Wright Laboratory

Leads laboratory discovery, development and transition of aeronautical technologies that enable the Air Force to remain the best in the world.

Wright Laboratory, Wright-Patterson AFB, Ohio, is responsible for developing materials, solid state electronics and manufacturing technologies for the entire Air Force community. Its parent product center is the Aeronautical Systems Center, also at Wright-Patterson.

Research and development is conducted by seven technology directorates in 170 facilities located at Wright-Patterson, and, in Florida, at Eglin and Tyndall AFBs.

Except for Manufacturing, each directorate performs the full spectrum of basic research, and exploratory and advanced development.

Seven directorates

Materials explores new materials and processes for advanced aerospace applications.

Aero Propulsion and Power focuses on air-breathing propulsion and aerospace power technology, including high-performance/high-Mach air breathing propulsion applications.

Armament develops conventional armament technologies and integrates those into air-vehicle and other delivery platforms.

Avionics conducts research and development in the fields of weapon delivery systems, reconnaissance, electronic warfare, navigation, communications, avionics integration and offensive sensors.

Flight Dynamics conducts the full spectrum of flight vehicle research including aircraft structures, flight control, aeromechanics, and vehicle subsystems.

Manufacturing Technology is the focal point for planning and executing an integrated manufacturing program across the Air Force.

Solid State Electronics is responsible for electronic device research and development in microelectronics, microwaves and electro-optics.

Robert McCarty, program manager for Wright Lab's Directly Formed, Frameless Canopy Program, Wright-Patterson AFB, Ohio, checks the placement of triangulation points on an injection-molded aircraft canopy. These visual cues are vital to testing the canopy's ability to protect aircrews from potentially fatal bird strikes.

Just the facts...

- **Wright Lab is the Air Force's largest laboratory complex.**
- **The lab has an annual budget of about $1 billion.**
- **About 2,500 military and civilian employees work in Wright Laboratory.**
- **Roughly two-thirds of its people have degrees in science and engineering disciplines, with almost half that number having advanced degrees.**
- **Researchers at Wright Lab, working with experts from Ohio and across the United States, are exploring ways to use advanced composites to repair and reinforce bridges and roads.**

Advanced composites, well known for strength and resistance to corrosion, have the potential of prolonging the service life of aging concrete structures. Composites are also useful in sporting equipment and for medical applications, such as in artificial joints.

Using science and technology from their four major laboratories, AFMC's four

Product Centers

develop and acquire systems, such as aircraft, spacecraft, electronics and missiles.

Aeronautical Systems Center

Researches, develops, tests, evaluates, and initially acquires aeronautical systems and related equipment for the Air Force.

Aeronautical Systems Center, the host unit at Wright-Patterson AFB, Ohio, is concerned primarily with strengthening strategic forces, modernizing and expanding tactical air forces, and expanding airlift capabilities.

The center's major strategic program thrusts include the B-1 and the B-2 bomber, a manned bomber for penetrating enemy air defenses through low-observable or stealth technology.

Other major programs include the C-17; the F-22; the T-1A, T-3A and Joint Primary Aircraft Trainer System; simulators; electronic warfare and reconnaissance systems; and the AC-130U and MC-130H special operations aircraft. ASC also manages the Tri-Service Standoff Attack Missile, a low-observable cruise missile capable of both air and ground launch. Under the broad heading of armament, the center oversees several non-nuclear weapon programs at Eglin AFB, Fla. ASC also manages the National Aero-Space Plane program, a joint Defense Department-NASA effort.

The center's Wright Laboratory, one of the four Air Force super laboratories, plays a vital role in providing advanced technologies critical to the development of weapon systems and other equipment. Its seven directorates perform the full spectrum of basic research and exploratory and advanced development in materials, aero propulsion and power, solid state electronics, avionics, armament, flight dynamics, and manufacturing.

The F-22 air superiority fighter

Just the facts...

❑ ASC controls roughly one-fifth of the entire Air Force budget annually.

❑ ASC's 1993 budget was $14.5 billion.

❑ ASC's work force totals more than 10,400 people -- nearly half of all government employees working on Wright-Patterson AFB.

❑ The 645th Air Base Wing manages 1,576 buildings on Wright-Patterson.

❑ Wright-Patterson has two runways: 12,000 feet and 7,000 feet in length.

❑ Wright-Patterson covers 8,145 acres.

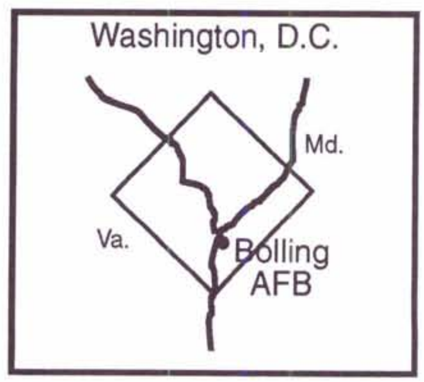
❑ Wright-Patterson is Ohio's largest employer at a single location, with a local area payroll exceeding $932 million annually.

❑ Wright-Patterson's Medical Center, one of six regional Air Force medical centers, has 301 beds and serves more than 60,000 beneficiaries within a 40-mile radius of the base.

Attractions

❑ The U.S. Air Force Museum attracts 1.5 million visitors annually.

❑ Huffman Prairie Flying Field, one of four sites in a new national park, is where Orville and Wilbur Wright taught themselves and others to fly.



Kelly AFB, Texas
San Antonio Air Logistics Center

Kirtland AFB, N.M.
377th Air Base Wing
Phillips Laboratory

Los Angeles AFB, Calif.
Space and Missile Systems Center

Gunter Annex, Maxwell AFB, Ala.
Standard Systems Center

McClellan AFB, Calif.
Sacramento Air Logistics Center

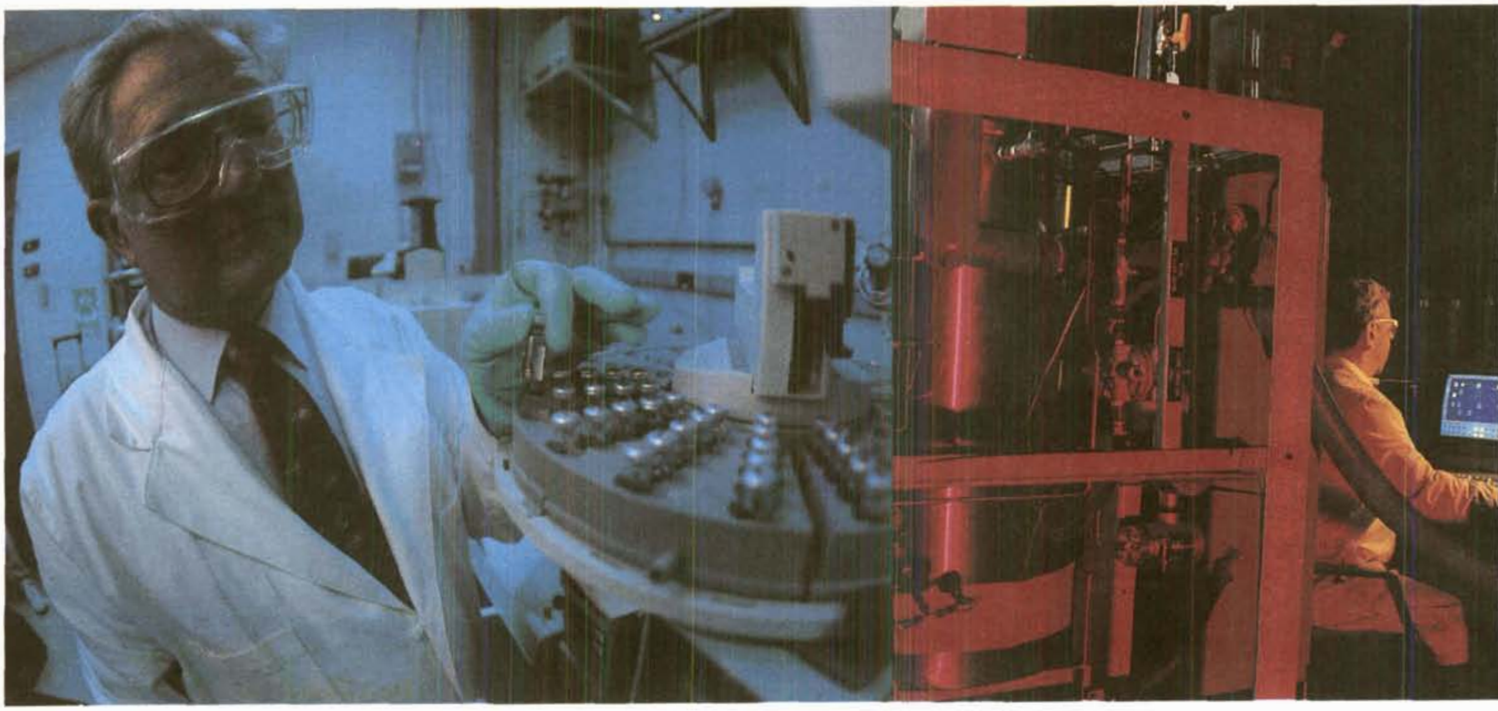
Newark AFB, Ohio
Aerospace Guidance and Metrology Center

Robins AFB, Ga.
Warner Robins Air Logistics Center

Tinker AFB, Okla.
Oklahoma City Air Logistics Center
Communications Systems Center

Wright-Patterson AFB, Ohio
AFMC Headquarters
Aeronautical Systems Center
Air Force Security Assistance Center
USAF Museum
Wright Laboratory
Materiel Systems Center

We Offer The Following



Dramatic changes in the U.S. Defense environment have opened a world of exciting and profitable new opportunities for business and industry. While the primary mission of Air Force Science and Technology continues to maintain the best Air Force in the world, a new direction is emerging – the support of a healthy economy and bolstering America's global competitiveness. By offering a wealth of research and technology, this new open-door policy can provide countless new opportunities for your company.

Our sign is out...we're open for your business!

Technology Transfer – Open Access for Business

Our new Air Force mission encourages the offering of technology developed through Air Force facilities for commercial applications. We call it Technology Transfer.

Through these transfers, the Air Force is making its research laboratories, test centers and depots available to business and industry like never before, creating partnerships in "dual-use" technologies. Considered the most promising of all the research endeavors underway by the Air Force, dual-use technologies both meet the needs of our military forces and offer significant potential for commercial application.

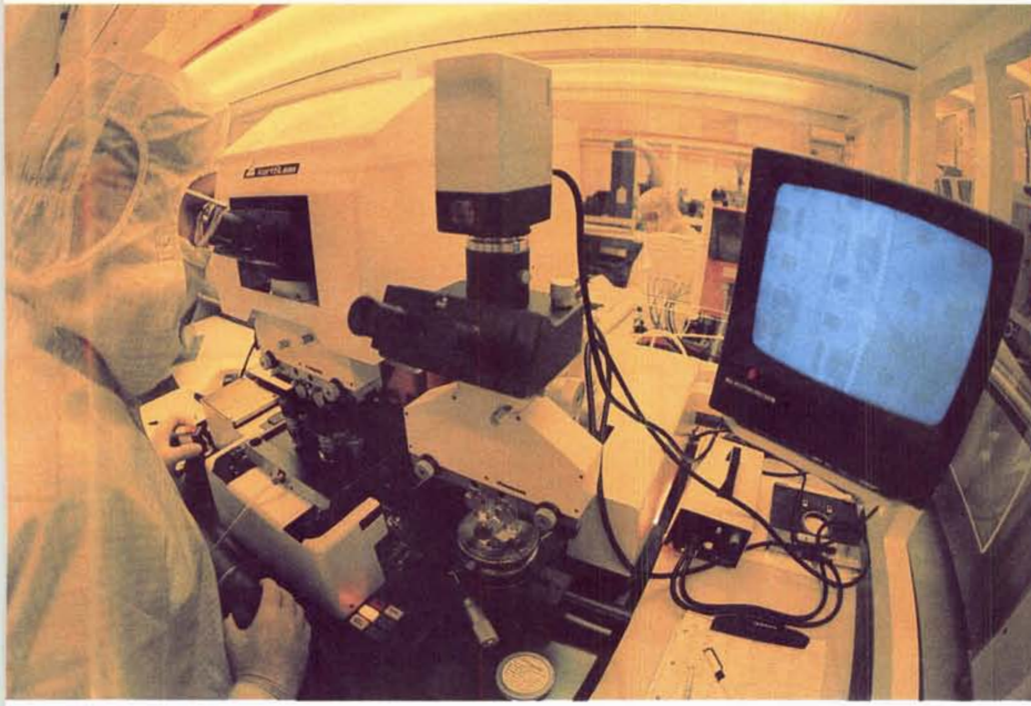
Consider just a few of these Technology Transfer Partnerships ongoing today:

- Computer innovations used in "Smart Weapons" are being explored to help radiologists detect and pinpoint breast cancer much earlier than before.
- A type of Phased Array radar system is being placed on school buses to warn drivers that children are close by.
- Self-lubrication ball bearings – used in the space shuttle – are being looked at for use in several commercial manufacturing situations.
- Imagine a pedestrian footbridge that never wears out, never rusts, never needs painting and requires virtually no maintenance. Now being tested, this bridge is so lightweight it can be lifted into place by a few workers using a small hoist.

Technology from war-related research is being utilized in the fields of medicine, education and countless other peacetime applications.

There are many other success stories where dual-use technologies have been quickly and effectively transferred from Air Force Laboratories to the commercial marketplace. Many more opportunities are waiting for you. Can your organization get involved in Technology Transfer? The answer is Yes! We work through simple agreements with

...Right Here On Earth.



individual companies, alliances and partnerships. Call us today to discover the possibilities.

New Technology – New Opportunities

Imagine the opportunities – open access for your business or industry group to proven, world-class technology and thousands of skilled and experienced Air Force scientists and engineers. One-of-a-kind test facilities and sophisticated scientific research facilities, coupled with nearly 90 years of aerospace research and development, give you access to the best technology in the world.

Air Force Laboratories create technology solutions that are fully transferable to the commercial marketplace. Many are already on the shelf and waiting to be used.

These laboratories also have a reputation for solving some very tough technical problems. Laboratory expertise is available in a broad array of technical areas, including:

- Electronics
- Communications
- Education/Instruction
- Environmental Sciences
- Industrial Design
- Public Safety
- Engines and Power Sources
- Health Care
- Transportation
- Energy
- Materials and Structures
- Human Factors
- Manufacturing

Products, Solutions, Partnering

Technology Transfer offers a winning combination of scientific expertise, unique facilities and highly sophisticated equipment, all focused on helping your business create new products, solve tough technical problems and become more competitive in the global marketplace through partnering. Already, companies from the fields of automobile design, aviation and medical research are lining up to take advantage of the awesome capabilities that the Air Force Laboratories have to offer. To enhance your company's position in the new global arena, give us a call at our *"Tech Connect"* Hotline and discover how we can bring new signs of life to your project.

Infrared night vision research may someday aid the visually impaired.

Air Force Science and Technology. Offering business new possibilities.

Air Force
SCIENCE & TECHNOLOGY

Air Force & Industry – Today's Partnership for Tomorrow's Technology.

Talk to us. Call Air Force *"Tech Connect."*
(800) 203-6451

Map of major facilities and installations

Arnold AFB, Tenn.
Arnold Engineering Development Center

Battle Creek, Mich
Cataloging and Standardization Center

Bolling AFB, D.C.
Air Force Office of Scientific Research

Brooks AFB, Texas
Armstrong Laboratory
Human Systems Center

Davis-Monthan AFB, Ariz.
Aerospace Maintenance and Regeneration Center

Edwards AFB, Calif.
Air Force Flight Test Center

Eglin AFB, Fla.
Air Force Development Test Center

Griffiss AFB, N.Y.
Rome Laboratory

Hanscom AFB, Mass.
Electronic Systems Center

Hill AFB, Utah
Ogden Air Logistics Center

Electronic Systems Center

Develops and acquires command, control, communications, computer and intelligence systems.

Systems developed and acquired by the Electronic Systems Center, Hanscom AFB, Mass., monitor enemy forces and allow U.S. commanders to make quick decisions based on the latest information, and to quickly transmit those decisions to the troops in the field.

Crewmembers operate consoles inside an Airborne Battlefield and Control III capsule. The program is managed by ESC.

These systems include: mission planning systems, the Airborne Warning and Control System, the Ballistic Missile Early Warning System, the Joint Surveillance Target Attack Radar System, and the North American Aerospace Defense Command center in Cheyenne Mountain, Colo.

Although civilian contractors perform the actual design and manufacturing, ESC manages the process from start to finish, making the customer's operational needs the number one priority.

ESC personnel begin by finding out just what the customer needs and defines systems best able to meet those needs.

After soliciting bids, ESC people select the best contractor to do the work and monitor the process. They then test the final product to make sure it meets customer needs.

Technology for these advanced systems is developed by the Rome Laboratory at Griffiss AFB, N.Y., one of the Air Force's four super laboratories. One Rome Lab organization, the Electromagnetics and Reliability directorate, is located at Hanscom.

ESC recently took control of three former Air Force Communications Command units. These organizations make ESC the Air Force center for research, development and acquisition of command, control, communications, computers and intelligence systems.

Just the facts...

❑ **The center's annual budget is nearly $3.1 billion.**

❑ **The center is ranked as the fourth largest industrial organization in Massachusetts.**

❑ **ESC employs more than 4,490 people and has an annual payroll of $653 million.**

Newly gained units

❑ **Standard Systems Center, located at the Gunter Annex, Maxwell AFB, Ala., provides cradle-to-grave support for all Air Force standard computer and communications systems needed by wing and warfighting commanders.**

❑ **Communications Systems Center, Tinker AFB, Okla., provides integrated communications-computer systems and services both before and during war and in peacetime for Air Force and specified DOD agencies.**

❑ **Materiel Systems Center, located at Wright-Patterson AFB, Ohio, provides critical information systems, giving the necessary logistics support to keep Air Force units and weapon systems ready in peace and war.**

Human Systems Center

Prepares, maintains, protects and enhances human capabilities and human-system performance.

Armstrong Laboratory scientist man-rates the F-15E onboard oxygen generating system.

Human Systems Center, Brooks AFB, Texas, is the Air Force agent for human-centered research, development, acquisition and specialized operational support at both the individual and total force levels. The center works in four functional areas to meet current and future human-centered operational requirements: crew-system integration, crew protection, environmental protection and force readiness.

HSC's Armstrong Laboratory conducts research and support activities in aerospace medicine, occupational and environmental health, human systems technology, environmental remediation and compliance, and human resources development.

The Human Systems Program Office, the U.S. Air Force School of Aerospace Medicine and the 648th Air Base Group are also major center units.

The School of Aerospace Medicine trains all aerospace medical people in the Air Force, including doctors, nurses and technicians.

The Human Systems Program Office develops, acquires and sustains systems that touch almost everyone in the Air Force. These endeavors include aircraft life support, Air Force uniforms, chemical defense equipment, computer training aeromedical and environmental systems and the automation of administrative functions.

The 648th Air Base Group maintains the base. Associate units include the NASA Lunar Depository, the Air Force Center for Environmental Excellence, the Air Force Medical Support Agency, the 615th School Squadron, 6906th Electronics Squadron and the U.S. Army Medical Research Detachment.

Just the facts...

- **HSC's work force totals 3,218 military and civilian employees.**
- **HSC's annual payroll is more than $100 million.**
- **About 5,000 students attend courses at the U.S. Air Force School of Aerospace Medicine every year.**
- **The NASA Lunar Depository, an associate unit located at Brooks, houses 50 kilograms of lunar material.**

History

- **HSC traces its origins back to 1918 when the Medical Research Laboratory was formed at Hazelhurst Field, N.Y.**
- **Brooks became the Aerospace Medical Center headquarters in October 1959. This was the first step in placing management for aerospace medical research, education and clinical medicine under one command.**
- **On Nov. 21, 1963, President John F. Kennedy dedicated four buildings housing the Aerospace Medical Division headquarters and the Air Force School of Aerospace Medicine. It was his last official act before his assassination the next day.**

Space and Missile Systems Center

Designs and acquires space and missile systems, and completes satellite on-orbit checkouts after launch before turning systems over to other federal agencies.

The Space and Missile Systems Center, Los Angeles AFB. Calif., has operating sites throughout the country, including the operating location detachment at NASA's Johnson Spaceflight Center, Houston, Texas; Detachment 2 at Onizuka AFB, Calif.; and Detachment 9, Vandenberg AFB, Calif.

SMC is also the parent center of the host unit at Kirtland, AFB, N.M. -- the 377th Air Base Wing.

The 377th ABW supports Kirtland's more than 150 organizations, including the Phillips Lab, another of the Space and Missile Systems Center's operating sites.

SMC's Detachment 10, Norton AFB, Calif., supports the Peacekeeper in Minuteman silos. The center also manages the Advanced Strategic Missile Systems program that does advanced development of ICBM subsystems.

The center manages several Ballistic Missile Defense Organization programs designed to detect and destroy enemy missiles. Additionally, it works closely with the Air Force Space Command, Peterson AFB, Colo., the prime user of military space systems.

The center maintains communications and data handling operations with the Air Force Satellite Control Network at Space Command's Falcon AFB, Colo., and Onizuka AFB.

Launch programs SMC supports and manages include rocket boosters: Atlas II, Titan II and Titan IV. It also supports military missions on the space shuttle and assists Space Command in satellite tracking, data acquisition, and command and control.

A Titan IV/Centaur space launch vehicle successfully lifts the first Milstar communications satellite from Cape Canaveral AFS, Fla. Milstar is one of SMC's major space programs.

Just the facts...

❑ **SMC's work force totals 8,700 employees worldwide.**

❑ **The center has an annual budget of more than $5 billion.**

❑ **The center supports the following space programs:**

- **Navstar Global Positioning System**
- **Defense Satellite Communications System**
- **Milstar Satellite**
- **Defense Support Program**
- **Titan IV Launch Vehicle**
- **Defense Meteorological Satellite Program**
- **Peacekeeper**

❑ **Aerospace Corporation, a non-profit and federally funded organization, provides continuity to the center's programs through its technical expertise in space systems.**

Weapon systems are tested and evaluated in AFMC's three

Test Centers

Each test center has world-class facilities not found elsewhere in the Defense Department, and sometimes nowhere else in the world.

Air Force Development Test Center

Tests and evaluates non-nuclear munitions, electronic combat systems and navigation/guidance systems.

The Air Force Development Test Center, Eglin AFB, Fla., is the heart of a team comprising the complete munitions life cycle -- from initial concept through development, acquisition, experimental testing, procurement, operational testing and, finally, combat.

"Team Eglin" is a partnership between AFDTC, Air Force Materiel Command's Wright Laboratory and Aeronautical Systems Center, and Air Combat Command's U.S. Air Force Air Warfare Center and 33rd Fighter Wing.

The center's 46th Test Wing manages the overall test and evaluation program. Eglin has extensive ground facilities and about 30 aircraft of various types. The test wing controls all of the land test ranges throughout the 724-square-mile base complex.

Major tests on or above the AFDTC's ranges involve all types of equipment, including aircraft systems and subsystems, missiles, guns, bombs, rockets, targets and drones, high-powered radar and airborne electronic countermeasures equipment.

These systems are tested in a variety of environments and simulated combat conditions. The wing's 46th Test Group at Holloman AFB, N.M., operates a rocket-sled test track.

An F-16 soars over Eglin AFB carrying the Dispenser Weapon System, DWS-24. The system is being flight tested at Eglin for a commercial company under a new DOD program. The DWS-24 is an advanced "fire and forget" munitions dispenser system planned for use on the F-16 and other aircraft. As the DWS-24 approaches its target, submunitions are ejected from each side of the unit and form a precise pattern on the ground that covers an area up to 1,000 feet wide and 3,000 feet long.

Among the group's unique facilities are the 10-mile, high-speed test track; two radar target scatter measuring facilities; and the Defense Department's Central Inertial Guidance Test Facility.

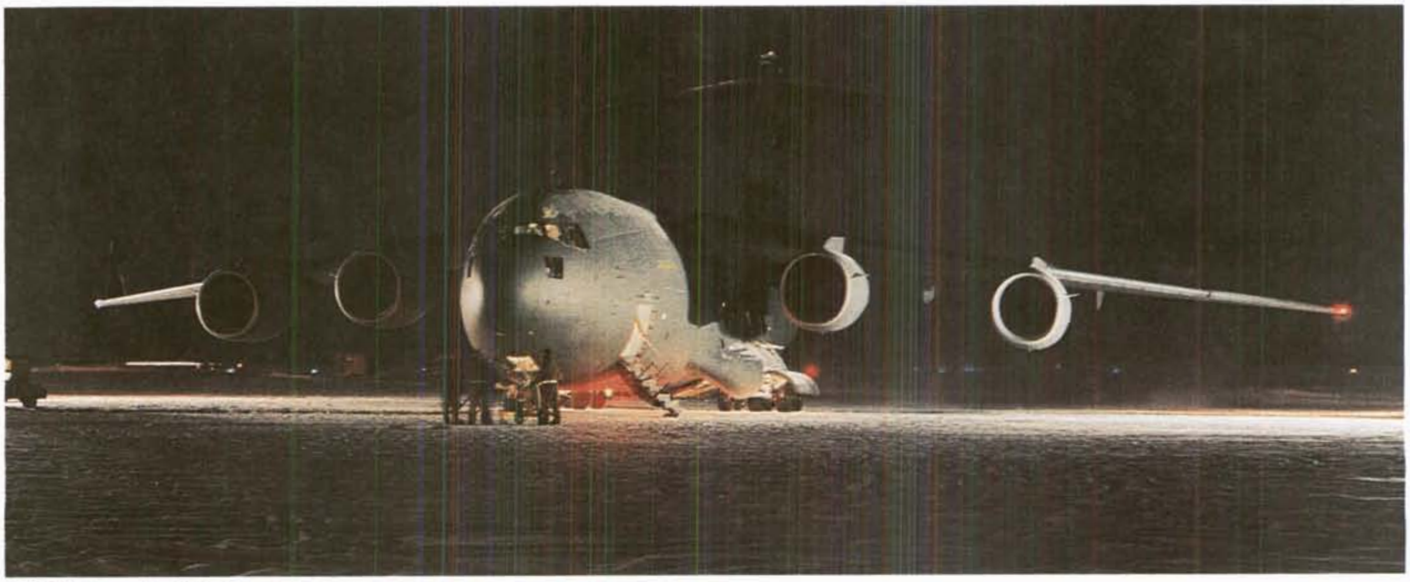
The quality of Eglin's infrastructure and services helped the base win the Air Force 1992 Installation Excellence Award.

Just the facts...

- **Eglin's annual payroll is more than $494 million.**
- **Eglin controls 86,500 square miles of water ranges in the adjacent Gulf of Mexico.**
- **The base is two-thirds the size of Rhode Island.**
- **The center's 96th Air Base Wing supports services the center and more than 50 associate units, including more than 70,000 active duty members, civilians, retirees and dependents in the local area.**
- **Its regional hospital serves more than 77,000 beneficiaries.**
- **Eglin's transportation squadron is the largest in the Air Force, with more than 2,700 vehicles.**
- **Eglin also runs one of the largest mobility centers in the Air Force. It is responsible for mobilizing more than 5,400 people and 22,000 tons of cargo in support of wartime taskings.**
- **Eglin earned the Gen. Thomas D. White Natural Resources Conservation Award, part of the 1993 Air Force Environmental Awards.**

Air Force Flight Test Center

Tested all the aircraft in the Air Force inventory and is currently testing the B-2, F-22 and C-17.



C-17 Globemaster III before an arctic mission.

The Air Force Flight Test Center is the host unit at Edwards AFB, Calif.

The center's work force -- civilian, military and contractor -- work together to flight test and evaluate new aircraft and upgrades to aircraft already in inventory for Air Force units, the Department of Defense, NASA and other government agencies.

These include improvements to radar weapons delivery and navigation systems, and a system to give tactical pilots the ability to strike ground targets from low altitudes at night and in adverse weather.

The center develops, operates and maintains the Edwards Flight Test Range and Utah Test and Training Range. It also operates the U.S. Air Force Test Pilot School.

AFFTC resources include the test and evaluation mission simulator, the Benefield Anechoic Chamber, Ridley Mission Control, and the integration facility for avionics systems testing.

Historical perspective

In February 1948, the Air Force Flight Test Center was activated at Edwards, originally called the Muroc Bombing and Gunnery Range, and later Muroc AFB.

The base played an important role in training fighter and bomber crews throughout World War II.

Muroc, with its excellent weather and dry lake bed (an immense natural runway for emergency landings) was ideally suited for year-round flight testing. Over the years, the lake bed has saved countless lives and aircraft.

Muroc was renamed Edwards AFB in December 1949 in honor of Capt. Glen W. Edwards, a test pilot killed in the crash of an experimental YB-49 Flying Wing.

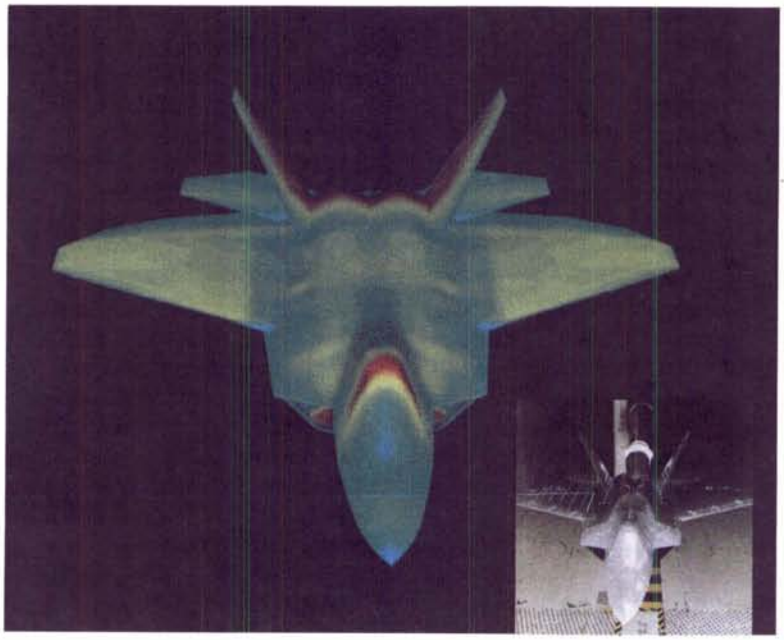
Just the facts...

- **Edwards sits on 301,000 acres on the western edge of the Mojave Desert.**
- **The base's population is composed of 4,400 military, 10,800 civilians and 6,420 dependents.**
- **The nation's first jet- and rocket-powered aircraft made their first flights at Edwards.**
- **Men and aircraft first exceeded Mach 1 through 6 and first flew above 100,000, 200,000 and 300,000 feet at Edwards.**
- **In 1977, the space shuttle's approach and landing tests were conducted at Edwards .**
- **The first shuttle landings from space began in April 1981.**
- **The B-2 bomber made its maiden flight at Edwards in 1989, the F-22 in 1990 and the C-17 in 1991.**

Arnold Engineering Development Center

Possesses the most advanced and largest complex of flight simulation test facilities in the world.

The Arnold Engineering Development Center at Arnold AFB, Tenn., is a vital national asset, serving America's flight-simulation test needs for more than 43 years.



An F-22 fighter as shown on a computer model using Computational Fluid Dynamics, a relatively new discipline being used as a tool to complement wind tunnel tests. The modeling shortens the time needed to get complex information on aerodynamic effects. INSET: A model of the F-22 is being prepared for testing in the center's 16-foot transonic wind tunnel.

The center's diverse collection of test assets includes more than 50 aerodynamic and propulsion wind tunnels, rocket and turbine engine test cells and space environmental chambers.

Its customers include the Air Force, Army and Navy; private industry; NASA, FAA, allied foreign agencies and academic institutions.

Engineers and scientists at the center test aircraft, missile, and space systems and subsystems at the conditions they will experience in actual flight.

They frequently use models of weapon systems during testing, many of which are created by the center's craftspeople.

A research and technology program is conducted at the center to develop advanced testing techniques and instrumentation, and to support the design of new test facilities.

The center identifies long-range testing requirements, conducts facility concept studies and technology projects supporting facility planning efforts.

The program focuses on many areas, such as hypersonics, turbine engine testing and space testing.

The program's results ultimately translate into specifications for new or improved facilities, improved instrumentation, procedures and computational tools.

Just the facts...

❑ AEDC engineers have contributed to the development of many of the nation's top priority aerospace programs, such as the F-22, the F-117A, F/A-18E/F, B-2 and the space shuttle.

❑ AEDC support to oeprational systems also includes store separation testing for the F-15 and B-1B, engine testing for the T-37 and F-5, and rocket-motor testing for Minuteman and Peacekeeper missiles.

❑ The center has opened its doors to commercial testing, a win-win relationship for the Department of Defense and the private sector. Public-private partnering most recently helped Pratt & Whitney achieve FAA certification for its 4084 engine. This engine will power the new Boeing 777 airliner in upcoming flight tests.

❑ Of the center's test units, 27 have capabilities unmatched anywhere in the world. They can simulate flight conditions from sea level to outer space, and from subsonic to Mach 20 velocities.

❑ Four high-vacuum space chambers simulate space conditions in the altitude range of 200 miles.

❑ Only 10 percent of the center's 3,500 employees are government workers. The remainder are employed by one of the center's three support contractors or their subcontractors.

Weapon systems receive depot-level maintenance and overhaul during their life cycles at the command's five

Air Logistics Centers

Their customers include many foreign countries in addition to Defense Department organizations.

Ogden Air Logistics Center

Provides worldwide logistics support for the entire Air Force inventory of intercontinental ballistic missiles and F-16 Fighting Falcons.

Ogden ALC workers perform maintenance on a Navy F/A-18 Hornet.

The Ogden Air Logistics Center, Hill AFB, Utah, provides worldwide engineering and logistics management for the F-16 Fighting Falcon, the world's largest fleet of fighter aircraft.

Ogden also maintains the C-130 Hercules and the Navy/Marine F/A-18 Hornet.

In 1993, the center performed 2.25 million manhours of maintenance and modifications on more than 300 F-16s, 29 F-4s and 50 C-130s, while beginning interservicing work on 36 Navy F/A-18s.

The center also provides logistics support to 21 countries flying more than 3,000 F-16 aircraft.

Ogden ALC has worldwide logistics management and maintenance responsibilities for the nation's fleet of intercontinental ballistic missiles, including Minuteman and Peacekeeper.

The center operates the Air Force's worldwide overhaul and repair facility for all aircraft landing gear, brakes, struts and wheels.

Ogden is the Air Force's leading provider of rocket motors, small missiles, air munitions and guided bombs, photonics imaging and reconnaissance equipment, simulators and training devices, avionics, hydraulics and pneudraulics instruments, and computer software.

Just the facts...

- **Hill provides support for the 900,000-acre Utah Test and Training Range, DOD's largest over-land special use airspace within the continental United States.**
- **More than 22,000 training sorties and 1,000 test sorties are flown on the range each year by all military services.**
- **The UTTR is used for testing munitions and propellants up to the most powerful ICBM rocket motors and explosive components.**
- **As Utah's largest employer, Hill has some 16,000 employees.**
- **Of Hill's total work force, approximately 8,500 civilians and 1,900 military are assigned to Ogden ALC.**
- **The annual base payroll totals approximately $570 million.**
- **Hill employees contribute roughly $550,000 each year to the Combined Federal Campaign.**
- **Hill's overall economic impact in Utah is estimated to be $1.9 billion annually.**
- **Hill provides the logistics support for the entire Air Force inventory of intercontinental ballistic missiles.**
- **Hill is the logistics manager for all landing gear, air munitions, solid propellants and explosive devices used throughout the Air Force.**

Oklahoma City Air Logistics Center

Provides specialized logistics support -- management, maintenance and distribution -- to defense weapon systems across the globe.

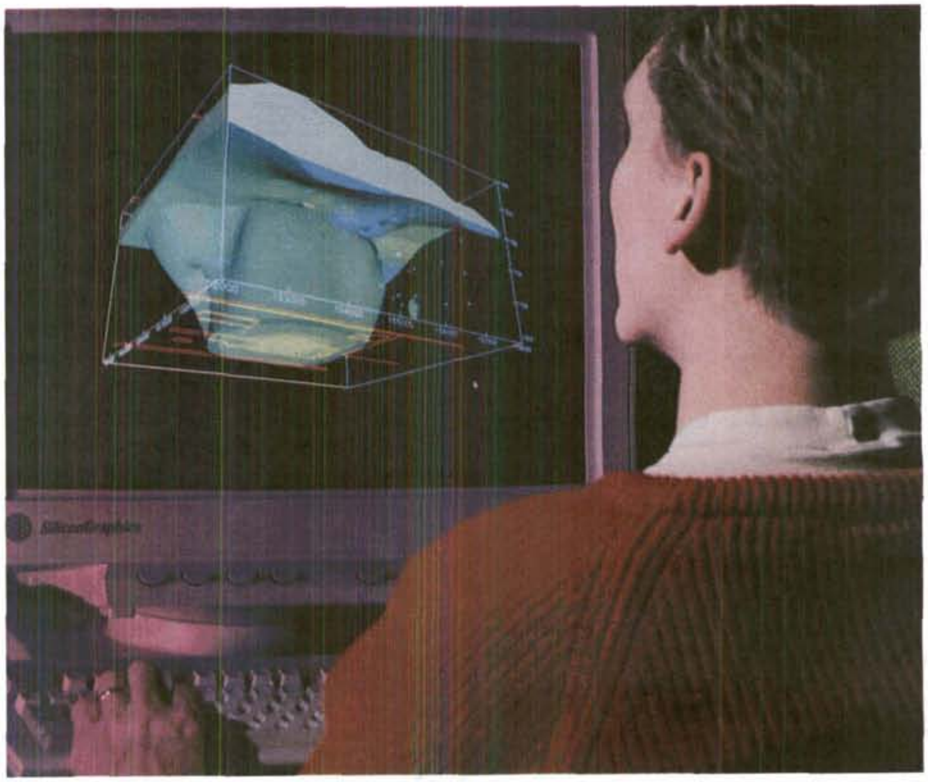
The Oklahoma Air Logistics Center, Tinker AFB, Okla., manages or provides comprehensive depot maintenance on 1,416 aircraft, including the B-1B, B-2, B-52 and KC-135.

The center also manages logistics support done by contractors for the E-3, KC-10, VC-25, VC-136 and 25 other aircraft that transport high-ranking government officials across the globe.

In 6 million square feet of indoor maintenance area, the center manages more than 17,000 jet engines ranging from Korean War-vintage J-33s (for the T-33) to state-of-the-art B-2 engines such as the F118.

The center manages the Air Launched Cruise Missile, Short Range Attack Missile, Harpoon and Advanced Cruise Missile.

The center's Commodities Directorate tracks more than 70,000 parts used on defense weapon systems



An environmental engineer views a three-dimensional model to see levels of contamination below the Earth's surface. This cutting edge software lets Tinker engineers select the best methods to clean up restoration sites and monitor progress.

Just the facts...

- **Tinker blazed a trail in alternative fuel use by adapting some 551 vehicles to run on propane, compressed natural gas and electric battery power.**

- **Nearly 300 fleet vehicles have been converted to dual-fuel CNG, giving Tinker the distinction of having the largest dual-fuel armada in Oklahoma — and one of the largest in the nation.**

- **Tinker is the only AFMC base whose gates now enclose the Navy. Fleet Air Reconnaissance Squadron Three and Four, both located at Tinker, conduct the Navy's "Take Charge and Move Out" mission -- providing a survivable strategic communication link between national leaders and the country's arsenal of strategic nuclear weapons.**

- **The joint Air Force and Navy physical security program, first of its kind in the Department of Defense, is located at Tinker and serves as a model for other installations.**

- **Tinker is Oklahoma's largest single-site employer with more than 21,000 employees.**

- **Tinker's total economic impact is $2.8 billion.**

- **In 1993, the base payroll topped $785 million.**

- **Tinker has formed a number of technology advancement coalitions to address a wide spectrum of environmental issues. One such venture will join all Department of Defense installations in Oklahoma as a coalition to crossfeed information on compliance actions and improve the partnership between the EPA and federal facilities.**

Sacramento Air Logistics Center

The Air Force's high technology center for communications-electronics, space-based ground systems, manufacturing and aircraft systems.

The Sacramento Air Logistics Center, located at McClellan AFB, Calif., is known throughout the Department of Defense as a high technology industrial center.

It has advanced capabilities in composites, microelectronics, electro-optics, software, hydraulics/pneudraulics, system engineering, flexible manufacturing, and environmental technologies — products of a $400-million investment over the past decade.

The center manages communications-electronics systems, aircraft, and, as the predominant space logistics support facility, the ground control equipment that monitors space vehicles.

In the spirit of dual use, the center is offering McClellan's capabilities, facilities, and technologies and experience for interservicing, and supporting commercial applications. McClellan's nondestructive inspection workloads are expanding to include other DOD services.

The center hosted the Navy's F-14 in its unique full-aircraft nondestructive inspection facility, and the Army's Apache helicopter in both the full-aircraft facility as well as in the Nuclear Radiation center for blade inspection.

The center also is deeply concerned for the environment. Since 1980, the Sacramento ALC has spent more than $160 million to clean up areas damaged by past waste management practices. In addition, the center is continually searching for ways to prevent future contamination.

With McClellan's Hufford Stretch Wrap machine, Ron Shore can stretch and form up to 15-foot lengths of steel.

Just the facts...

- **SM-ALC houses the only industrial nuclear reactor in DOD.**

- **In an agreement with the University of California, Davis Medical Center, the university will use the McClellan's nuclear reactor to study neutron boron capture therapy.**
  This effort could result in a regional treatment center for previously inoperable brain tumors.

- **SM-ALC is the largest industrial employer in Northern California.**

- **McClellan's work force totals more than 14,100 people.**

- **The base's annual payroll is $583 million.**

- **The base's economic impact on the 10-county area surrounding McClellan is $2.2 billion.**

- **The base's groundwater treatment plants typically remove as much as 3,000 pounds of contaminants from the groundwater each day.**

- **McClellan and a local utility company are developing advanced technologies for zero-pollution electric vehicles. This cooperative agreement will create civilian jobs and help establish an electric vehicle industry in Sacramento.**

- **Under a cooperative research and development agreement between the center and Ford, Chrysler and General Motors, an environmentally compliant casting facility will be developed for the domestic automobile industry and DOD.**

- **Since 1985, the center has cut hazardous waste generation by more than 70 percent and reduced volatile compounds emissions by 64 percent.**

San Antonio Air Logistics Center

Provides worldwide logistics support for weapon systems including the C-5, T-37, T-38 and the new C-17.

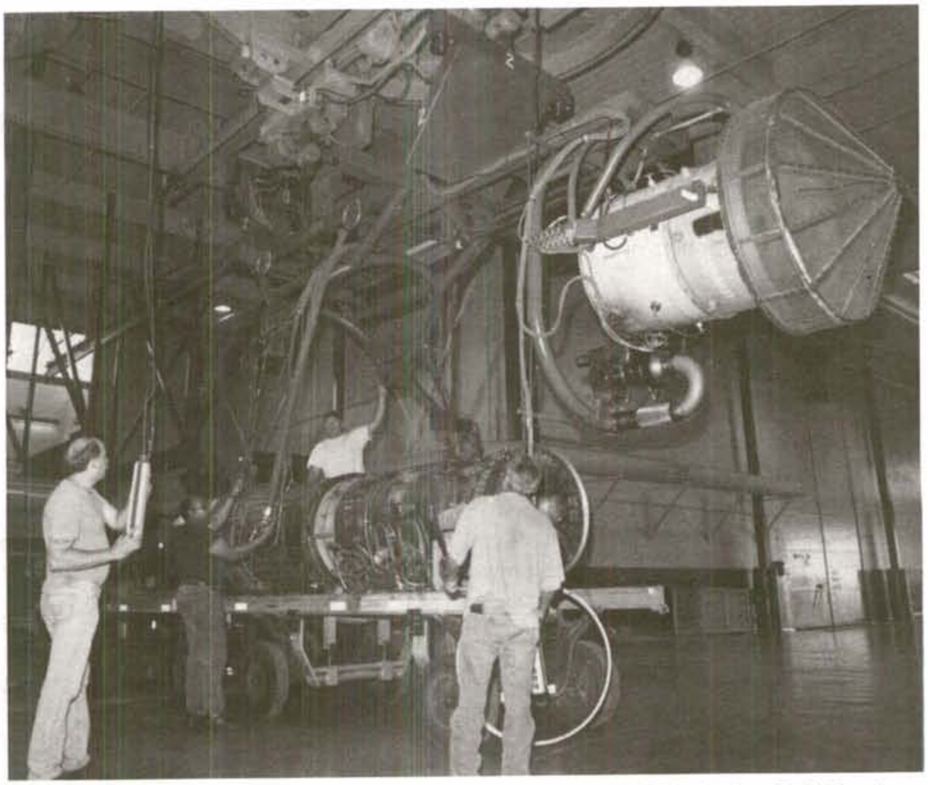
The San Antonio Air Logistics Center, located at Kelly AFB, Texas, manages, repairs and ships engines, engine modukes and other components for a variety of aircraft, ranging from the massive C-5 cargo and troop transport to the F-16 fighter. The center is also a depot repair facility for C-5 and T-38 trainer aircraft. Funding has been approved for a new facility to handle repair of the C-17, the Air Force's newest jet transport aircraft.

In addition to engine and aircraft work, the center also manages and maintains a wide variety of electronic, aerospace ground, electro-mechanical and nuclear component support equipment.

The center manufactures and machines parts for engines and fuel control systems with a unique stereo lithography system, one of the few of its kind in the world.

The center also manages the Air Force nuclear ordinance inventory, determines requirements for fuels and lubricants used by the Air Force, and supports all liquid missile propellants used by the Air Force and NASA.

Also managed by the center is the Air Force's fleet of boats and ships, and the 51st Munitions Squadron, Lackland AFB, Texas. The squadron supports the standard air munitions package, and the standard tank, rack, adaptors and pylon package program.



An F100 engine is readied for testing at one of the center's test cells following maintenance. San Antonio ALC is one of two AFMC centers with engine overhaul capability. Two-level maintenance, currently underway at Kelly, has helped improve the management process.

In 1992 the center won a major three-year contract worth an estimated $34.8 million. The contract calls for modification and inspection of the giant C-5A and C-5B transport aircraft.

In 1991 the center dedicated a new bead-blasting corrosion control facility for stripping paint from aircraft. Not only is it the largest in the Air Force, it also incorporates the latest technology and will accomodate the C-5 and C-17 aircraft.

Just the facts...

- **The center manages more than 19,000 aircraft engines.**
- **The ALC also manages the Air Force inventory of some 50,000 non-aircraft engines -- more than 75 percent of the Air Force's total engine inventory.**
- **During fiscal 1993, 35 aircraft underwent periodic depot maintenance at the center: eight B-52s, 24 C-5s, and three T-38s. Two C-5A aircraft underwent Speedline modifications.**
- **The combined payroll at the center is $656 million.**
- **Some 248 aircraft engines and 2,708 modules were overhauled or repaired.**
- **The fiscal 1993 budget for the center was $7.1 billion.**
- **The center employs 11,676 civilians and 1,367 military people.**
- **Another 3,750 full-time civilians and 3,640 military people work in associated organizations.**

Warner Robins Air Logistics Center

Provides worldwide logistics management for the F-15 Eagle, the C-141 Starlifter, the C-130 Hercules, utility aircraft, helicopters, missiles, and other vehicles.

The Warner Robins Air Logistics Center, located at Robins AFB, Ga., manages more than 200,000 items that represent the full range of avionic functions and technology, including aerospace communications and navigation equipment; airborne bomb and gun-directing systems; target acquisition systems; and most Air Force airborne electronic warfare equipment.

The center provides cradle-to-grave logistics management support and depot-level maintenance for the F-15, C-141 and C-130 aircraft.

The center also provides cradle-to-grave management support for the Low-Altitude Navigational Targeting Infrared for Night System, the Joint Tactical Information Distribution System, the Worldwide Military Command and Control System, and supports firefighting equipment and vehicles of all types.

The center is also the technology repair center for life support equipment, instruments (gyroscopes), airborne electronics and aircraft propellers.

Warner Robins is responsible for procurement, supply and maintenance functions for most Air Force bases along the East Coast, as well as the Atlantic Missile Test Range, Newfoundland, Labrador, Greenland, Iceland, Bermuda, the Azores and all Air Force and Security Assistance Program activities in Europe, Africa and the Middle East.

Workers perform a center wing box replacement, a process, designed by Warner-Robins ALC engineers. It's the largest structural repair ever accomplished by an organic depot.

Just the facts...

- **Warner Robins ALC is the host unit at Robins.**
- **The base has 40 tenant organizations.**
- **Robins will become the main operating base for the E-8 Joint Surveillance and Target Attack Radar System aircraft as it enters the Air Force inventory.**
- **Robins is Georgia's largest industrial complex, covering more than 8,790 acres.**
- **At the end of fiscal 1993, Robins employed 13,380 civilians and 4,547 military.**
- **In fiscal 1993, military and civilian salaries totaled $686.3 million.**

Many development and logistics functions are handled in AFMC's

Specialized Centers

These centers focus on critical areas such as basic research, cataloging and standardization, metrology, security assistance and "retired" weapon systems.

Aerospace Guidance and Metrology Center

The single Air Force center for repairing inertial guidance and navigation systems for missiles and aircraft, and for certain aircraft displacement gyroscopes.

The Aerospace Guidance and Metrology Center, located at Newark AFB, Ohio, provides a full range of engineering and consultation services on inertial systems to the Air Force and other Defense Department agencies.

The center establishes, maintains and performs overall technical direction and management of the Air Force Metrology and Calibration Program.

AGMC operates the Air Force Measurement Standards Laboratory. It provides technical and procedural direction for operation of a single, integrated measurement system. The center also designs and performs periodic calibration and certification of measurement standards used in all precision measurement equipment laboratories.

The center repairs guidance and navigation systems for:

A-7D/E	F-16
AC-130	F-111
B-1B	KC-135
B-52G/H	Minuteman I, II, III
C-5A	Peacekeeper
F-4	RF-4
F-15	SRAM

Technicians at the Aerospace Guidance and Metrology Center, Newark AFB, Ohio, assemble the stable member of a Peacekeeper missile.

Just the facts...

❑ Newark AFB covers about 70 acres.

❑ The base's capital assets and equipment are valued at more than $300 million.

❑ It employs more than 1,500 people

❑ Newark's annual payroll totals approximately $70 million.

❑ AGMC is the only center in the Air Force where inertial guidance and navigation for missiles and aircraft, as well as certain aircraft displacement gyroscopes, are repaired.

❑ Through interservice agreements, AGMC also repairs inertial guidance and navigation systems components on the Navy's A-7E, RF-4, and Class 688 Attack Sub and the Army's OV-1D and Position and Azimuth Determining System.

❑ The center is pursuing privatization since Newark was selected for closure by the 1993 Base Closure and Realignment Commission.

Aerospace Maintenance & Regeneration Center

Stores preserved aircraft indefinitely with a minimum of deterioration and corrosion because of the meager rainfall, low humidity and alkaline soil near Tucson, Ariz.

The Aerospace Maintenance and Regeneration Center, located at Davis-Monthan AFB, Ariz., is a service organization that provides for the storage, regeneration, reclamation, and disposal of aircraft and related aerospace items as well as selected non-aerospace, out-sized, and specialized items.

Related aerospace items in storage include production tooling, engines, pylons, pylon load adapters and airframe components.

AMARC's 750 employees maintain the specialized skills and knowledge necessary to work on more than 50 different types of aircraft.

The center's primary customers include the Air Force, Army, Navy, Coast Guard, foreign military sales countries, and other non-Department of Defense agencies. AMARC provides services tailored to each customer.

The center is much more than a storage facility. Historically, about one-fourth of the aircraft received for storage are eventually prepared for flight or ground shipment to support its customers' needs.

AMARC is also the elimination site for heavy bombers under the terms of the Strategic Arms Reduction Treaty (START).

Aircraft stored at the Aerospace Maintenance and Regeneration Center.

The center also supports specialized training efforts of the FBI, FAA, Federal Law Enforcement Training Center, aircraft battle damage repair school, and other DOD agencies.

AMARC is organized with three key processes:

Process-In puts aircraft into storage and maintains them while they're in storage.

Process-Out removes aircraft from storage and prepares them for flight.

Reclamation removes parts and assemblies from stored aircraft in support of customer requirements.

Just the facts...

- **In fiscal 1993, AMARC received 671 aircraft and processed 911 aircraft into storage.**
- **AMARC returned 165 aircraft and 27,056 parts to the government in 1993 for a total of $734 million.**
  As the center's budget was $50 million, the amount represents a $14.65 return for each dollar the center spent.
- **AMARC will eliminate about 350 B-52 aircraft over a three-and-a-half-year period to comply with conditions of the Strategic Arms Reduction Treaty.**
- **As of Sept. 30, 1993, the center had 4,527 aircraft in storage from the Air Force, Army, Navy and Coast Guard.**
- **Also in storage are 41 Titan missiles, 48 communications-electromagnetic-meteorological units, and 180 photo-reconnaissance shelters.**

Air Force Office of Scientific Research

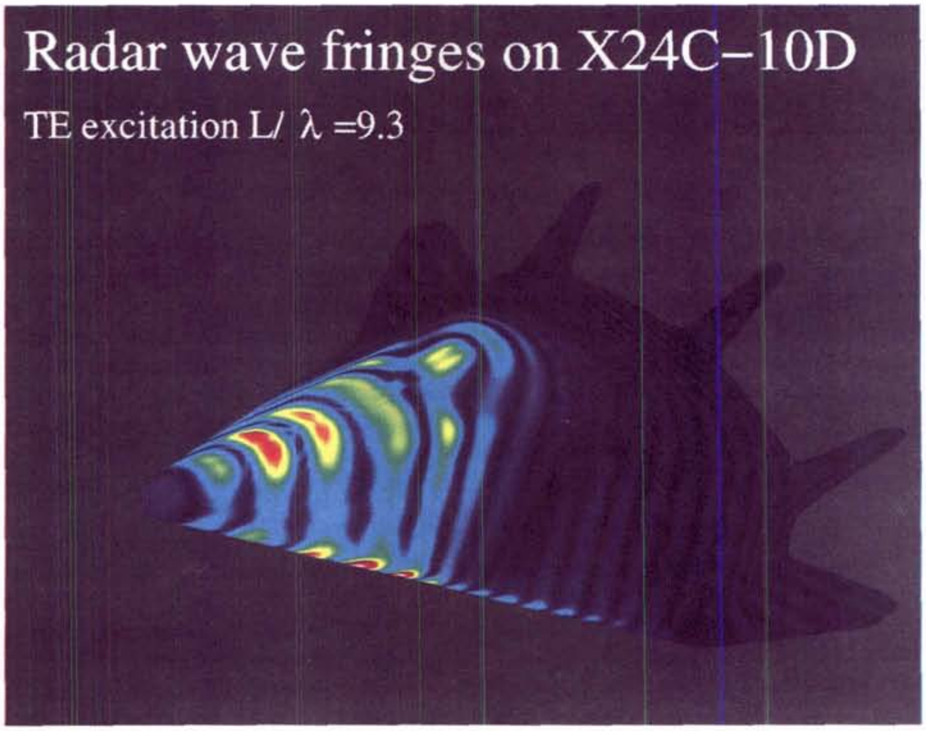
Directs the basic science and engineering research program for the Air Force.

The Air Force Office of Scientific Research, Bolling AFB, D.C., sponsors basic research programs in Air Force laboratories, academia, U.S. industry and other government agencies.

The office reports significant technology transfers, transitions and product applications to more than 200 customers annually -- half to U.S. industry and the other half to Air Force organizations -- for advanced research, test, logistics or systems applications.

AFOSR's $300 million investment consists of roughly 1,600 grants and contracts to 375 academic institutions and industrial firms, and more than 100 intramural research efforts performed by the four major Air Force laboratories.

AFOSR investment strategy exploits scientific opportunities deemed relevant to Air Force research, by balancing "technology pull" -- what customers need -- with "research push" -- scientific achievements showing promise for new technologies.



The figure demonstrates the newly-acquired computational electromagnetic simulation capability for the radar cross section of an aircraft. The invisible radar wave fringe pattern on the X24C-10D reentry vehicle is made visible by this computational technique. To make this high-performance computation technique possible, a large system of equations must be solved describing the scattering electromagnetic wave phenomena around any object in the free space. Since the electromagnetic wave is generated at the speed of light and with a very short wavelength, the required computing speed to mimic the physics must also be very high. In fact, the computation has reached a rate of nearly 10 billion calculations per second on a parallel computer.

Just the facts...

❑ AFOSR programs support 40 major research areas in four major scientific areas:
- **Aerospace and materials sciences**
- **Chemistry and life science**
- **Physics and electronics**
- **Mathematical and geosciences**

❑ AFOSR also manages educational and scientific exchange programs, bringing research talent to the Air Force labs and allowing Air Force laboratory researchers to work at renowned university, industry and government labs.

❑ To foster international cooperation, AFOSR operates the European Office of Aerospace Research and Development, London, and the Asian Office of Aerospace Research and Development, Tokyo.

❑ The Frank J. Seiler Research Laboratory, Colorado Springs, Colo., offers Air Force Academy faculty and cadets access to a first-class research environment and performs basic research to support both academy research interests and Air Force technology objectives.

Cataloging and Standardization Center

Prevents costly entry of duplicate items into the DOD inventory and ensures accurate logistics data exist for the 2.3 million items used by the Air Force.

The Cataloging and Standardization Center in Battle Creek, Mich., is the focal point for getting accurate logistical data or help in locating hard-to-find parts.

This centralized agency provides a single face to the customer, performing functions previously done as separate functions at the five air logistics centers.

CASC's 400 employees use their technical expertise in more than 500 federal supply classes to serve customers in AFMC, other Air Force commands, other military services and civilian agencies.

Core services

Item Entry Control compares new items proposed for weapon systems to currently cataloged items, prevents duplicate items from entering the inventory and technically assesses new items for performance and cost.

Logistics Data Management maintains the catalog data once an item is assigned a national stock number. CASC is directly or indirectly responsible for 2.3 million supply items and provides tailored service to meet unique customer requirements.

Program/Data System Management supports the infrastructure -- data systems, policy, procedures, and programs -- in addition to performing cataloging and standardization work on individual items.

Specifications and Standards protects Air Force interests by identifying critical performance requirements for reliability and maintainability, while promoting conversion of DOD documents into more simplified commercial specifications and standards.

Customer Assistance operates a worldwide, 24-hour customer helpline that receives nearly 500 calls per week. CASC answers 78 percent of these calls within one duty day and all others within 48 hours.

HELPLINE

Phone: **DSN 932-HELP**
COMM (616) 961-HELP

Fax: **DSN 932-7252**
COMM (616) 961-7252

Email casc:
911@cadis01.casc.dlsc.dla.mil

Electronic bulletin board:
DSN 932-4340
COMM (616) 961-4340

Air Force Security Assistance Center

Establishes, implements and manages the Air Force security assistance programs assigned to the command.

The Air Force Security Assistance Center, Wright Patterson AFB, Ohio, ensures that the U.S. Air Force meets commitments to its foreign customers.

The center's country managers negotiate foreign military sales cases directly with foreign countries to provide a wide variety of materiels and services to support their weapon systems.

AFSAC also helps prepare cases managed by the secretary of the Air Force, and supports more than 80 foreign governments, allies and international organizations.

AFMC currently manages more than 4,000 foreign military sales cases totaling nearly $100 billion.

The center's Logistics Support Group, headquartered in Riyadh, Saudi Arabia, is responsible for the in-kingdom program management of U.S. Air Force security assistance programs with Saudi Arabia totaling more than $15 billion.

The center maintains several unique programs including military assistance programs authorized by the president of the United States to provide specified materiel and services without cost to designated friendly foreign governments during emergencies, and support to drug enforcement efforts by providing military articles and training free of charge to governments fighting drug trafficking.

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(Air Force Science & Technology Report)

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Forward section of a B-1 is being prepared for testing at Rome Lab's Newport, N.Y, site.

Document Separator

IMPACT OF RELOCATION OF AL/CFT CENTRIFUGE ON THE DOD ACCELERATION MISSION

- Armstrong Laboratory (AL) Centrifuge is **one of only three** DoD research centrifuge facilities

  -- **Armstrong Laboratory Centrifuge at Brooks AFB**; rapid onset (+6.0 Gz/s); lowest operational cost; most productive of all DoD centrifuges (including training facilities)
  - nearly **6,000 centrifuge exposures in 1994**; on pace to **exceed 6,000 in 1995**.

  -- **Dynamic Environmental Simulator at Wright-Patterson AFB OH**; does **not** have rapid G-onset capability (only 0.8 +Gz/s); allows performance testing

  -- **Naval Air War Center at Warminster PA**; rapid onset (+6.0 Gz/s); allows performance testing; high operational costs; scheduled for closure

- Impact of Relocation of AL Centrifuge to WPAFB

  -- Estimated **MINIMUM 12 MONTHS** "down time" (**disassembly, packing, transport, unpacking, reassembly, interface with new support facility at WPAFB, unmanned equipment rating, manned rating, new training / retraining of centrifuge operations staff**)

  -- No rapid onset centrifuge research capability in DoD; [interrupts research **on G-Protective Effects of the Advanced Technology Anti-G Suit (ATAGS), Female Acceleration Tolerance Enhancement, COMBAT ACE** (chemically hardened COMBAT EDGE - pressure breathing for G), **+9 to +12 Gz tolerance, Effects of Specific Exercise on G Tolerance, Effects of Sortie Surge on G Tolerance, Various equipment testing protocols (including helmet-mounted displays, advanced oxygen masks, etc.)**]

  -- No Pilot Instructor Training (PIT) program training support for Randolph AFB (up to **480 pilots/yr**) (an AFMC - AETC Memorandum of Agreement)

  -- No medical evaluation capability for DNIF pilots nor research support for the medical consult service (AL/AOC)

  -- No ACC training backup for Holloman AFB centrifuge mission (**111 pilots** trained at AL Centrifuge facility during Holloman "down time" in Apr & May 95)

  -- Reductions in or elimination of medical/biomedical acceleration training of physicians and aerospace physiologists in **USAFSAM-sponsored courses** (Aerospace Medicine Primary - **120/yr**; Residency in Aerospace Medicine - **60/yr**; Aerospace Physiology Officers Course - **25/yr**)

Document Separator

BROOKS AIR FORCE BASE

Interactions with Local Military Installations, San Antonio and South Texas

Prepared by:
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15 April 1995

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Kelly Air Force Base

- **Advanced Hybrid Oxygen Systems--Aircraft.** The continued development by the Human Systems Center of an Advanced Hybrid Oxygen System will provide the information necessary to retrofit the C-5 fleet with a self-producing oxygen system.

- **Combat Edge.** The Human Systems Center ensures personal equipment developed through program COMBAT EDGE will have proper documentation and management control to permit transfer of the program to the San Antonio Air Logistics Center.

- **Computer systems training.** The School of Aerospace Medicine has a Cooperative Research Development Agreement for Computer Systems Training with the Electronic Warfare Center at Kelly Air Force Base.

- **Health physics emergency response and radioactive waste.** Emergency response to potential nuclear mishaps using response kits at Kelly Air Force Base. Support to radiological waste site clean-up and safe material disposal.

- **Integrated weapon system management.** The Human Systems Center is responsible for the sustainment of human systems, and the sustainment activities of life support, and chemical and biological systems in concert with the San Antonio Air Logistics Center.

- **Occupational medicine.** The Kelly Air Force Base Occupational Medicine Department is the only bona fide program within the Air Force. The department provides consultations, formal training for Residents in Aerospace Medicine, and pilot testing support for the evaluation of safety and injury prevention programs.

- **Pre-production and production of Transportable Blood Transshipment Center.** Human Systems Center activities at Kelly Air Force Base cover tasks performed by each organization in all activities involved with the pre-production and production of the Transportable Blood Transshipment Center.

- **Shared faculty.** Kelly Air Force Base provides instructors for the School of Aerospace Medicine occupational medicine courses and assists in training public health officers.

- **Software Maintenance, Test Program support and Maintenance Skills Tutor.** The Human Systems Center provides functional and managerial responsibilities associated with the Maintenance Skills Tutor software support.

Lackland Air Force Base

- **Wilford Hall Medical Center.** The 70th Medical Squadron provides support to WHMC in four areas: (1) Faculty for Ophthalmology Residency, (2) Low-vision expertise, (3) Rotation of students to 70th MDS, and (4) Forensic Dentistry Program for dental residents.

  - **Clinical rotations.** Wilford Hall Medical Center provides clinical rotations for Phase III Residents in Aerospace Medicine.

  - **Instructor support.** The School of Aerospace Medicine teaches entomology and vector-borne diseases for Wilford Hall Medical Center, Kelly Air Force Base and the Armstrong Laboratory.

  - **Assistance in Red Flag training.** The School of Aerospace Medicine provides instructors for the field training portion of Red Flag at Wilford Hall Medical Center.

  - **Shared faculty and instructors.** Wilford Hall Medical Center provides subject matter experts in various courses of the school.

  - **Coordination.** The Air Force Medical Support Agency contacts the Air Force Defense Medical Logistics Standard Support System personnel at Wilford Hall Medical Center on a daily basis.

  - **Medical consultants.** The Air Force Medical Support Agency has direct access to research and clinical practice consultants at Wilford Hall Medical Center in more then 40 specialty areas for policy, planning, design input, and technological innovation.

  - **Epidemiologic support.** Wilford Hall Medical Center relies on the Epidemilogic Research Division's computer to meet Department of Defense required turnaround time for pap smears. This division shares lab services with WHMC thereby reducing duplication and costs.

  - **Medical specialty support.** Due to geographical location, Wilford Hall Medical Center can provide timely infectious disease and immunology consultation for major projects.

  - **Ophthalmology research.** Ophthalmology research is conducted jointly between Wilford Hall Medical Center, and the Armstrong Laboratory to look at eye disorders to determine if people with evidence of retinal detachment, pigmentary dispersion syndrome (a potential type of glaucoma) can safely fly.

Lackland Air Force Base (Continued)

- **Basic Military Training Center.** The Armstrong Laboratory screens all Air Force recruits for rubella, rubeola, and pregnancy, with a three day turnaround; evaluate and monitor physical fitness and nutrition programs for trainees; and provide the center with disease surveillance for trainees to prevent epidemics during training.

  - **Multi-dimensional Aptitude Battery.** This is a comparison between a computerized and a written test. A computerized version of the Multi-dimensional Aptitude Battery is being developed. Air Force recruits are administered this test to allow comparison with the written version.

  - **Testing Air Force recruits.** The Armstrong Laboratory established a unique, world class 36,453 square foot facility at Lackland Air Force Base, equipped with 200 computer-based test stations, as well as paper and pencil testing. This allows for testing of 30,000 recruits a year to provide research basis for the development of new selection and classification tests for enlisted, officer and aircrew personnel.

Randolph Air Force Base

- **Aeromedical services support.** The 70th Medical Squadron provides aeromedical support to the 12th Medical Group in four areas: (1) Flight surgeon support to the 12th Medical Group, (2) Flight surgeon support to the Navigator Training Program, (3) A flight surgeon flies with Navigator Training Aircraft, and (4) the 12th Medical Group Radiology Department supports 70th MDS mammography program.

- **Recruiting service support.** The 70th Medical Squadron supports the Health Professions Scholarship Program by providing physical exams to student participants and through summer rotations and visits to the clinic.

- **Flying training.** The 559th Flying Training Squadron at Randolph Air Force Base provides five weeks of flying training for Phase II Residents in Aerospace Medicine and provides orientation flights for students attending the Aerospace Medicine Primary course..

- **Aircraft availability.** The 12th Flying Training Wing at Randolph Air Force Base provides aircraft for flight surgeons assigned to the School of Aerospace Medicine to accrue required flying time.

- **Consultant services.** Air Force Medical Support Agency personnel from all four of their divisions serve as consultants on assignments at the Air Force Military Personnel Center approximately four times a year.

- **Memorandum of Agreement -- G-induced loss of consciousness.** Because Air Education and Training Command (AETC) aircrews account for 90 percent of Air Force G-induced loss of consciousness incidents, AETC and the Air Force Material Command (AFMC) have established a centrifuge training agreement to improve G awareness and tolerance of AETC Pilot Instructor Training candidates at Randolph Air Force Base. This training is intended to enhance instructor pilot effectiveness in training student pilots relative to the anti-G straining maneuver in a high-G environment. In this agreement, the operational staff of the Armstrong Laboratory provides High-G Awareness Training for up to 20 AETC instructor pilot trainees per day at a daily cost to AETC of $2,000.

Randolph Air Force Base (Continued)

- **Advanced Spatial Disorientation Demonstrator (ASDD) Research pool.** Research to be conducted on the ASDD by Crew Technology Division personnel of the Armstrong Laboratory requires a pool of three types of Air Force subjects: (1) Pilot candidates who have not begun the flight phase of Undergraduate Pilot Training, (2) student pilots in the transition phase between T-37 and T-38 aircraft, and (3) pilots with operational flying experience in combat aircraft. Randolph Air Force Base currently is a pool of all three subject types, with no temporary duty costs associated. A move away from San Antonio will mean loss of this valuable yet inexpensive subject pool, significantly impacting the mission of the Spatial Disorientation Countermeasures Task Group.

- **Air Force Military Personnel Center support.** Timely receipt of mission support, due to geographical location, enables the Air Force Military Personnel Center to provide demographic and personnel data to the Armstrong Laboratory for major projects, survey design and review services.

- **Air Force Occupational Measurement Squadron support.** The Armstrong Laboratory and the School of Aerospace Medicine support personnel of the Air Force Occupational Measurement Squadron by providing unique aerospace medicine expertise which is invaluable in the occupational surveys for various aerospace medicine career fields in the Air Force .

- **Intelligent computer-assisted training.** The Armstrong Laboratory developed tools to support intelligent computer-assisted training for AETC at Randolph Air Force Base.

- **Data processing arrangement.** Provides for exchange of personnel data between the Armstrong Laboratory and the Air Force Military Personnel Center in support of research and analysis of officer selection and classification systems.

- **Training planning research with the Occupational Measurement Squadron.** The Armstrong Laboratory develops technologies to improve high-level Air Force training decisions, primarily to determine what, where, and when to train tasks required for successful job performance.

- **Individual differences in learning abilities.** Randolph Air Force Base provides subjects and data to Armstrong Laboratory to evaluate fundamental human abilities and uses this knowledge to vastly improve the selection and classification of both officer and enlisted personnel, which allows for extended testing times to administer complex learning tasks.

Fort Sam Houston

- **Computer training.** The School of Aerospace Medicine has a Cooperative Research Development Agreement with the Army Center for Public Works to supply computer training as part of a Water Management Issues Course.

- **Accessibility of Meat Laboratory and Cold Storage Facility.** Fort Sam Houston Academy of Health Sciences provides their facilities for training the School of Aerospace Medicine public health officers and apprentices.

- **Instructor support.** The School of Aerospace Medicine provides instructor support for Army Veterinary Officers Course and noncommissioned officer training programs teaching food safety and public health activities.

- **Subject matter experts.** The Army Academy of Health Sciences instructors support tropical medicine, deployment medicine and preventive medicine lectures in the Global Medicine course.

- **Cross-service cooperation opportunities.** The chief information officer for the Army's Medical Department is located at Fort Sam Houston, and the Air Force Surgeon General's chief information officer is located at the Air Force Medical Support Agency at Brooks Air Force Base, which leads to extensive cross-service cooperation opportunities.

- **Lead testing.** Air Force lead testing specimens for newborns are shipped to the Epidemiologic Research Division and transferred to Brooks Army Medical Center with rapid turnaround and low cost.

Other Federal Agencies

- **U.S. Air Force Academy Liaison Officer and Reserve Officer Training Corps Scholarship Administrator.** This officer, assigned to Human Systems Center, works with 22 San Antonio area high schools in advising, recruiting, and assisting high school students interested in competing for entry to the U.S. Air Force Academy or Air Force Reserve Officer Training Corps scholarships by both counseling students and parents and attending college fairs.

- **Acquisition professional development training support.** The 70th Training Squadron provides Acquisition Professional Development Program training to NASA personnel.

- **Naval support.** The 70th MS provides medical and dental support to Navy personnel in San Antonio.

- **Aerospace Medicine Primary Course for NASA.** School of Aerospace Medicine provides the Aerospace Medicine Primary course training for NASA Fellows in Space Medicine and prospective NASA research physicians.

- **Altitude decompression sickness research.** For more than 20 years, NASA has funded decompression sickness research at Brooks Air Force Base. Decompression procedures for extra-vehicular activity are determined by this work.

- **Audie Murphy Veterans' Hospital.** The Armstrong Laboratory provides clinical hyperbaric medicine services to patients from Audie Murphy Veterans Hospital.

- **Tactical information broadcast service.** The Human Systems Center delivers a Technical Information Broadcast Service Tutor using the Microcomputer Intelligence for Technical Training Tutor Technology. Product is supplied to the Air Intelligence Agency maintenance technicians.

- **Joint research in radiological and toxicological effects with NASA's Joint Space Center.** The Armstrong Laboratory's research in long-term health effects from ionizing radiation in space including current dosimetry experiments on-board the shuttle, and monitoring of high-energy proton exposed animals -- a protocol more than two decades old.

Other Federal Agencies (Continued)

- **Collaboration with NASA in environmental technology.** A cooperative effort regarding participation of the Air Force Center for Environmental Excellence and the Human Systems Center in the application of NASA environmental and occupational health technology information and developments.

- **Astronaut selection.** Armstrong Laboratory medical experts are routinely sent to NASA's Joint Space Center to conduct the astronaut psychiatric and psychological aviator selection evaluation, to support the Astronaut Selection Panel, and to consult with NASA Medical Operations to review and update psychiatric standards and selection procedures.

- **Other Human Systems Center and NASA activities.**

  - **Training of astronauts for shuttle launch G-profile.** Tests are conducted at the Armstrong Laboratory to provide Space Shuttle astronauts with +Gx centrifuge exposure which simulates the acceleration profile of the Space Shuttle's launch into earth orbit. Up to 25 astronauts have been trained annually.

  - **Pre-breathe protocols for extra-vehicular activity.** Investigation of the causes and potential cures of decompression sickness caused by exposure to low ambient pressures. Development of pre-breathe protocols for extra-vehicular activity and risk mitigation.

  - **Effects of microgravity on astronaut cognitive performance.** This cooperative NASA and Armstrong Laboratory experiment was to determine the interactive effects of microgravity and fatigue on cognitive performance of three shuttle crew astronauts during the flight of the Space Shuttle Columbia in July 1994. Follow-on studies for a June 1996 flight involve the interactive effects of fatigue, performance and microgravity.

  - **Medical and occupational health training.** NASA Flight Surgeon training and NASA personnel training in substance abuse and other areas are provided by Armstrong Laboratory to Joint Space Center. Considerable cross-training is done between the two institutes.

  - **Re-entry anti-G suit testing.** Tests of extended coverage anti-G suit to provide protection for astronauts during the long, low-level G-profile encountered during shuttle reentry into earth's atmosphere.

Other Federal Agencies (Continued)

- **Visual performance degradation in micro-gravity.** Astronaut reports of degraded near vision during space flight have raised concerns about visual performance of personnel working in space and next-generation ultra-high altitude aircraft. The Vision Function Tester, was flown aboard the Space Shuttle Endeavor in 1994. For the first time, recession of the visual near point in microgravity was demonstrated and quantified.

- **The effects of hyperbaric oxygen and gravity on leukocytes, apoptosis and multi-drug resistance.** Preliminary data obtained from an experiment onboard STS-67 indicates that apoptosis (programmed cell death) may be responsible in part for cellular atrophy in astronauts. In addition, data obtained from cells flown on STS-69 to determine how hyperbaric oxygen and low gravity may be used to identify mechanisms of multi-drug resistance so that multi-drug resistance found in cancer or bacteria cells may be reversed. Both these results are being investigated with follow-on studies planned.

- **Space launch risk assessment.** Improved computer modeling systems are being developed and used to estimate toxic corridors for normal and catastrophic abort scenarios. Enhancements to the existing models will provide more realistic toxic corridor estimation and should result in less frequent launch delays due to weather.

- **Microgravity on cardiovascular function.** The primate facilities are used to answer critical questions. A non-human primate model instrumental with blood flow and pressure sensors was designed and developed to study the effects of altering gravity on cardiovascular function. Also, developing spaceflight experiments using this model with NASA and the Russians, and conducted experiments using this model in a head-down tilt configuration during parabolic flight in a KC-135 aircraft. These experiments will extend our knowledge about the mechanisms of blood pressure control by making measurements of cardiovascular responses that cannot be obtained in human subjects and using this information to develop countermeasures against adverse effects of spaceflight.

Other Federal Agencies (Continued)

- **Exercise countermeasures.** The Armstrong Laboratory is evaluating the use of a single bout of cycling that elicits maximal effort performed 24 hours prior to reentry. This approach would eliminate significant use of time, oxygen, energy (food) and water now required to support extensive periods of exercise during spaceflight. This exercise may also enhance blood pressure regulation and help eliminate the major problems with fainting following return from spaceflight. A protocol is being designed with Joint Space Center for a space flight experiment.

- **Other medical and scientific collaboration.** Participate with NASA on the Space Technology Interdependency Group (STIG), co-chair the STIG Operations Committee, which sponsored the Workshops on Space Operations Applications and Research (SOAR). These conferences, held in Houston, are funded and co-chaired by the Armstrong Laboratory and NASA. AL personnel perform as members of NASA medical and scientific working groups and review committees, including astronaut selection panel, astronaut selection criteria review, NASA Human Factors Discipline Working Group (DWG), NASA Musculoskeletal DWG, NASA Artificial Gravity WG, NASA Exercise Countermeasure Project Task Force, and NASA Peer Reviews-Human Factors, Space Physiology, Innovative Research, NIH-NASA Neurolab.

San Antonio and South Texas

- **St. Mary's University.** Agreement for local doctoral students to gain practical experience performing research at Armstrong Laboratory.

- **Trinity University.** Research agreement on bioeffects of electromagnetic fields: Conduct joint research extending manpower for Air Force and collocated tri-service bioeffects research and systems testing for high energy microwave systems.

- **Texas A&M University.** Food and Safety Technology: Participate in joint research in methodologies for extrapolation of risk to human populations using limited test data and statistical approaches.

- **University of Texas Health Science Center.** Intelligent Tutoring Systems in Fundamental Skills: Develops intelligent tutoring systems for teaching English, math and science at the 9th grade level in the San Antonio area schools.

- **University of Texas at Austin.** The Release of Air Force Instructional Design Software: Develops state-of-the-art tools for instructional design automation and courseware authoring, resulting in improved learning and teaching environments.

- **Palo Alto College.** Environmental Technical Training: Provides technical and professional lecture hours and equipment access for junior college level education of environmental technicians.

- **University of Texas Health Science Center, University of Texas at San Antonio, Trinity University, Southwest Research Laboratory, Southwest Research Institute.** Joint Research on the Center of Excellence in Radiological Toxicology: Joint research on the biological effects of laser, microwave and visible electromagnetic energy and associated risks.

San Antonio and South Texas (Continued)

- **Adjunct faculty.**
  - Palo Alto College (2)
  - Our Lady of the Lake University (1)
  - St. Mary's University (5)
  - University of Texas at Austin (1)
  - Trinity University (1)
  - University of Texas at San Antonio Health Sciences Center (11)
  - San Antonio College (2)
  - Embry Riddle Aeronautical University Randolph Air Force Base (1)
  - University of Texas at San Antonio (3)
  - Rice University Summer Faculty Associate (1)
  - St. Philips College (1)

- **Consultants.**
  - Texas Education Agency on Master Teacher Program (1)
  - Exxon Corporation in Houston (1)
  - University of Texas at San Antonio (1)
  - NASA (1)
  - Southwest Research Institute (1)

- **Collaborative research projects with students and faculty.**
  - St. Mary's University (2)
  - University of Texas at Austin (2)
  - Trinity University (1)
  - Texas A&M University (4)
  - San Antonio College (2)
  - Embry Riddle Aeronautical University Randolph Air Force Base (1)
  - University of Texas San Antonio (1)
  - Rice University (1)

San Antonio and South Texas (Continued)

- **Public health training -- San Antonio Chest Hospital.** The School of Aerospace Medicine has a Memorandum of Understanding with the San Antonio Chest Hospital to provide hands-on public health training for residents in aerospace medicine. Residents in turn provide medical services for hospital customers.

- **Public health training -- Texas Department Of Health.** The School of Aerospace Medicine maintains a Memorandum of Understanding with the Texas Department of Health, Region 6 to provide field training in regional public health practice for residents in aerospace medicine. Residents provide free health care for customers.

- **Clinical rotations -- Texas Center for Infectious Diseases.** The Texas Center for Infectious Diseases provides clinical rotations for the School of Aerospace Medicine Phase III residents.

- **Instructor support.** The School of Aerospace Medicine provides instructor support for U.S. Department of Agriculture-sponsored meat inspection classes taught at the University of Texas at San Antonio.

- **Training for nurse anesthetists.** The School of Aerospace Medicine has a Memorandum of Understanding with the University of Texas Health Science Center to train nurse anesthetists at the nursing school in hyperbaric medicine.

- **Aerospace medicine primary training.** The School of Aerospace Medicine provides Aerospace Medicine Primary training for the physicians attending their residency in space medicine at the University of Texas Medical Branch at Galveston, Texas.

- **Classroom space.** The School for Aerospace Medicine provides classroom space to Palo Alto and Webster Colleges.

- **Shared and adjunct faculty.** The School of Aerospace Medicine provides instructors for masters in public health course at the University of Texas Health Science Center.

- **ACHE (San Antonio) Participation.** The administrator of the 70th Medical Squadron is president-elect of the Federal Healthcare Executives of ACHE (San Antonio).

San Antonio and South Texas (Continued)

- **Southeast San Antonio healthcare initiative.** The administrator of the 70th Medical Squadron is a key executive in Southeast San Antonio Healthcare Initiatives Task Force.

- **Greater San Antonio Hospital Council.** The 70th Medical Squadron supports the Greater San Antonio Hospital Council through: (1) Professional input in coordination of healthcare in South Texas, and (2) Rotation of students through 70th MDS.

- **Health Science Center support.** The 70th Medical Squadron supports the University of Texas Health Science Center through: (1) Faculty for Family Practice Program, (2) Students rotations at 70th MDS, and (3) Forensic Dentistry Course for School of Dentistry in association with the School of Aerospace Medicine.

- **Restoration Advisory Board.** Base-sponsored local civic/base membership. Co-chairs are civic/local area leader living near the base, along with director, Environmental Management. This group meets to publicly discuss base restoration projects and provide community members a forum to ask questions about the status of restorations planned or occurring at the base.

- **College and university enrollment.** Brooks Air Force Base personnel enrollment in the following San Antonio area colleges and universities
  - San Antonio College
  - Palo Alto College
  - Incarnate Word College
  - Our Lady of the Lake
  - St. Mary's University
  - Texas Lutheran
  - University of Texas at San Antonio
  - University of Texas at San Antonio Nursing School
  - University of Texas Health Science Center
  - Southwest Texas State University
  - Trinity University
  - St. Philips College
  - University of Houston Clear Lake
  - San Jacinto Community College

San Antonio and South Texas (Continued)

- **San Antonio area organizations working with Brooks Air Force Base Family Support Center.**
  - Army and Air Force Exchange Service
  - American Association of Retired People
  - Alamo Community College District
  - Alamo Federal Executive Board, Youth and Education Council
  - Allied Finance
  - American Testing and Technical Services
  - American Red Cross, Station Manager, Lackland Air Force Base
  - Applied Materials
  - Army Career and Alumni Program
  - Army Education Center
  - Austin Police Department
  - BDM Technologies
  - Baptist Memorial Hospital System
  - Bexar County Civil Service Commission
  - Bexar County Justice Center
  - Bexar County Sheriff's Office
  - Brown and Root Services Corp.
  - Greater San Antonio Chamber of Commerce
  - Southside Chamber of Commerce
  - Hispanic Chamber of Commerce
  - City of Austin, Fire Department
  - City of San Antonio, Department of Community Initiatives
  - City of San Antonio, Economic Development

San Antonio and South Texas (Continued)

- **The following San Antonio organizations have agreements to use the runways and apron.**
  - •• Southwest Research Institute-- Runway used for crash testing vehicles
  - •• H.E.B. Grocery Co. -- Runway used for local and regional annual truck driving safety contests
  - •• Brady Green Clinic -- Runway used to train bus drivers annually
  - •• VIA Metropolitan Transit -- Runway used for annual local and regional safety driving competition for truck drivers
  - •• Trans Tech Resources -- Runway used to test braking systems
  - •• EG & G Automotive Research -- Runway used to test types of vehicles for manufacturers
  - •• BFI Waste Systems -- Runway used for safe driving classes for BFI truck drivers
  - •• Bexar County Sheriff's Department -- Runway used for holding high speed and other driving classes for sheriff's department
  - •• Texas Department of Mental Health and Retardation -- Runway used to brief drivers on safe driving techniques
  - •• Alamo Area Council of Governments -- Runway used to hold high-speed and other driving classes for regional law enforcement departments
  - •• Club Miniature Aircraft Combat Association -- Runway used to fly RCA airplanes
  - •• San Antonio Road Runners -- 10K bi-annual run
  - •• Path Finders Central Texas Association -- Annual jogging competition
  - •• San Antonio Sports Car Association -- Apron used to host monthly car rallies
  - •• Young Astronaut's Rocket Club -- Apron used to launch homemade rockets
  - •• Alzafar Shrine Temple -- Apron used for state and international driving championship
  - •• Pad Rats Rocket Club -- Apron used annually to launch rockets

- **San Antonio companies that hold goods and services purchase agreements with the 70th Air Base Group.**

Federal Sales Services
Virus Reference Lab
Bergen Brunswig
Syncor
Universal Contact
Liquid Carbonics
Natwell
BVA
Micro-Bio
General Medical
Southwest Photo
AAA Stamp and Engraving Co.
Southwell Company
A-1 Transmission
AAMCO Transmission
Alamo Spring Co.
American Car Care Center
Atlas Body and Truck Shop
Bohls Bearing and Power Transmission Services
Cavazos and Sons
Cummins
Case
Commercial Body Co.
Kooling Systems of San Antonio
Domingo Vara Chevrolet
Diesel Injection
The Exhaust Center
Fiesta Dodge
Fruehauf Trailers
George's Body Shop
General Brake and Alignment
General Tire
Gillespie Ford
Gunn Chrysler
Goodyear Tires
Grande Truck Center, Inc.
Hydraulic Supply Services Co
Interstate Battery
Kuenstler Machinery
Meineke Discount Mufflers
Metalcrafters, Inc.
Allen Moving and Storage
American Transfer and Storage Co.
Amistad Transfer and Storage
Alamo Moving and Storage
Armstrong Moving and Storage
A-1 Freeman Moving and Storage
Allen Transfer and Storage
Austin Van and Storage, Inc.
Stock Yard Center Public Scales
Van De Walle Farm, Inc.
Ashley Salvage Co.
Big Tex Grain Co.
Allied Feed Mill
Alamo Interstate Truck Stop
Roegelein Co.
Southwest Livestock Exchange and Trucking Co.
Ryder
U-Haul
Jays Automotive BPA
Motor Mart
Hanke Automotive
Mission Automotive
Newco Radiator Service
Conley Lott Nichols Machinery Co.
JAYS Automotive Specialties
Moto Mart Auto Parts
Mission Auto Parts
Pee-Wee Hance
Bergen Brunswig
Quality Beverage Company
Ace Mart
SYSCO
Alamo Paint and Wallpaper
Acme Soap Co.
American West
American Wine Co.
American Refrigeration
Bel-Air Auto Supply
Big Red Bottling Co.
Builders Square
BUDCO, Inc.

Midas Muffler Shop
Northstar Dodge
Northside Towing
Ottmers Auto Services
One Stop Radiator and Air Conditioning Services
Phenix Glass
Rush GMC
River City Hydraulics, Inc.
S&W Trailer Service
Safe Lite Glass
Southway Ford
Safety-Kleen Corp.
San Antonio Equipment and Hydraulic
Santex International Truck
Service Parts and Machine Co.
Southwest Brake and Alignment
Stewart and Stevenson, Inc.
Texas Mobile Glass Inc.
Texas State Glass
Torrado Chrysler Plymouth
Tire Station Richard Calvillo
U.S. Auto Glass
Mission Wrecker Service
Red Arrow Freight Lines
Carretta Trucking Co.
Canada Dry Co.
Coachman Inn
Coca Cola Co.
Halo Dist Co.
The Home Depot
Labatt Food Service
San Antonio Coors
Meny's Frame
NAPA
Office Depot, Inc.
Paul's Trophy
Penland Co.
Powell Vacuum Cleaner Center
Sutherland Lumber
Sears Product
Texas Bottlers
Southway Ford, Inc.
Southwell Co.
Wang
Century Papers, Inc.
Overnight Transportation
Watkins Motor Lines
ACH Enterprises Travel and Tours
Brookhill Funeral Home
Atlantic and Pacific Moving Co.
Ziegler Glass, Inc.

San Antonio and South Texas (Continued)

- **The 70th Medical Squadron provides support and cooperation to the following San Antonio organizations.**

  - •• **City of San Antonio Emergency Medical Services.** (1) Medical response augmentation to City Disaster Plan, and (2) San Antonio Emergency Medical Service responds to after hours emergency calls on Brooks Air Force Base

  - •• **Alamo Federal Executive Board.** Representative to Youth and Education Committee

  - •• **San Antonio Federal Women's Program Mangers Council.** (1) second vice president, (2) leadership and executive management, and (3) Federal Women's Program manager for Brooks Air Force Base

  - •• **San Antonio Health Care Coordinating Council.** Professional input and coordination of healthcare in San Antonio

  - •• **Trinity University.** In conjunction with the Greater San Antonio Hospital Council, students in Healthcare Administration rotate through the 70th MDS

  - •• **St. Mary's University.** Family advocacy and social work lectures

  - •• **San Antonio Dental Society.** (1) National Children's Dental Health month and (2) School visits

  - •• **American Heart Association.** (1) Cardio-pulmonary resuscitation trainees for San Antonio (12,000+ trained) and (2) Health promotions programs interface and lectures

  - •• **CAMP.** (1) Board of directors and steering committee, (2) Medical Care, (3) Dental Care, (4) Camp Counselors, and (5) CAMP Jog-a-thon support

San Antonio and South Texas (Continued)

- **Public Affairs activities.** The Human Systems Center's public affairs office is the focal point for civic relationships between Brooks Air Force Base and the San Antonio area. Some of its community relations activities include:

  - **Tours.** To educate visitors to the activities at Brooks Air Force Base through visits to base facilities and functions. (1994 -- 142 tours, 3,557 visitors)

  - **Speakers bureau.** Brook Air Force Base scientists, engineers and other professionals visit schools and civic groups to present the Brooks Air Force Base mission. (1994: 134 speakers, 6,550 audience)

  - **Parades.** A highly visible part of Brooks Air Force Base civic involvement throughout South Texas. (1994: 18 parades, 500,000+ spectators)

  - **Science fairs.** Brook Air Force Base science and technology focus make it a natural to participate in the judging of regional science fairs. The Alamo Regional Science Fair alone used 114 judges from the base.

  - **Engineer for a day.** An annual Spring event at Brooks Air Force Base, high school student across San Antonio visit the base and observe first hand the activities of high-tech engineers in their workplaces.

  - **Fiesta.** Brooks Air Force Base is an active participant in San Antonio's annual Fiesta celebration. Brook Air Force Base ambassadors and senior leadership participate in more than 40 different Fiesta events during the 10-day period.

- **San Antonio Bar Association, Environmental Law and the St. Mary's University Law School -- Mentoring Program.** Brooks Air Force Base lawyers participate with local chapter affiliation of lawyers, interplay of local civic, governmental and federal concerns in the law. Review of current areas of emphasis or upcoming changes in legislation affecting local area programs. Mentoring program simply provides professional adjunct assistance to students in need in the local university setting.

- **Elementary school -- Recycling and environmental awareness programs.** Base environmental professionals' promotion of environmental programs, proper recycling techniques, and instilling earth concerns with youth.

San Antonio and South Texas (Continued)

- **Liaison Officer to the Civil Air Patrol.** There are approximately 30 cadets (all southside teenagers) that meet at Brooks Air Force Base each week. The base has provided the Civil Air Patrol with a room in Bldg. T638. In addition, the cadets have privileges at the enlisted dining facility. Senior patrol members, when performing official functions may utilized base transportation assets, temporary quarters facilities and such services as audiovisual support.

- **Shared trainer for San Antonio 2000.** The 70th Training Squadron personnel sought out due to expertise to provide metrics training, and youth and education counseling for San Antonio 2000 Councils composed of industry and governmental area professionals committed to lifelong learning, enhanced public schools and renewed community values. Partnerships consist of: City of San Antonio, Bexar County, The University of Texas at San Antonio, Greater San Antonio Chamber of Commerce, USAA, United Way of San Antonio, Alamo Community College District, and Brooks Air Force Base. National Disaster Medical System-Brooks' ambulances and crew responsible for ground transport for city patients.

- **San Antonio area schools that participate in Brooks Air Force Base Civilian Personnel Student Aid and Summer Hire Program.**
  - Highlands High School
  - McCollum High School
  - Harlandale High School
  - Sam Houston High School
  - Brackenridge High School
  - Fox Tech High School
  - Lanier High School
  - Burbank High School
  - South San High School
  - Southwest High School
  - Palo Alto College
  - San Antonio College
  - University of Texas at San Antonio
  - S E R Jobs For Progress, Inc. San Antonio

San Antonio and South Texas (Continued)

- **Brooks Air Force Base humanitarian donations.**
  - Oblates of Mary Immaculate
  - Habitat for Humanity Military House
  - Battered Women's Shelter (Bexar County)
  - Four Winds Ministries
  - Christian Senior Services
  - Children's Shelter of San Antonio
  - Gideon's San Antonio East Camp
  - San Antonio Food Bank
  - Children's Shelter of San Antonio
  - Four Winds Ministries
  - Christian Senior Services
  - Battered Women's Shelter
  - Randolph Special Activity Fund
  - Fisher House of Lackland Air Force Base
  - Archdiocese of San Antonio
  - Knights of Columbus, Deaf Program
  - Meals On Wheels

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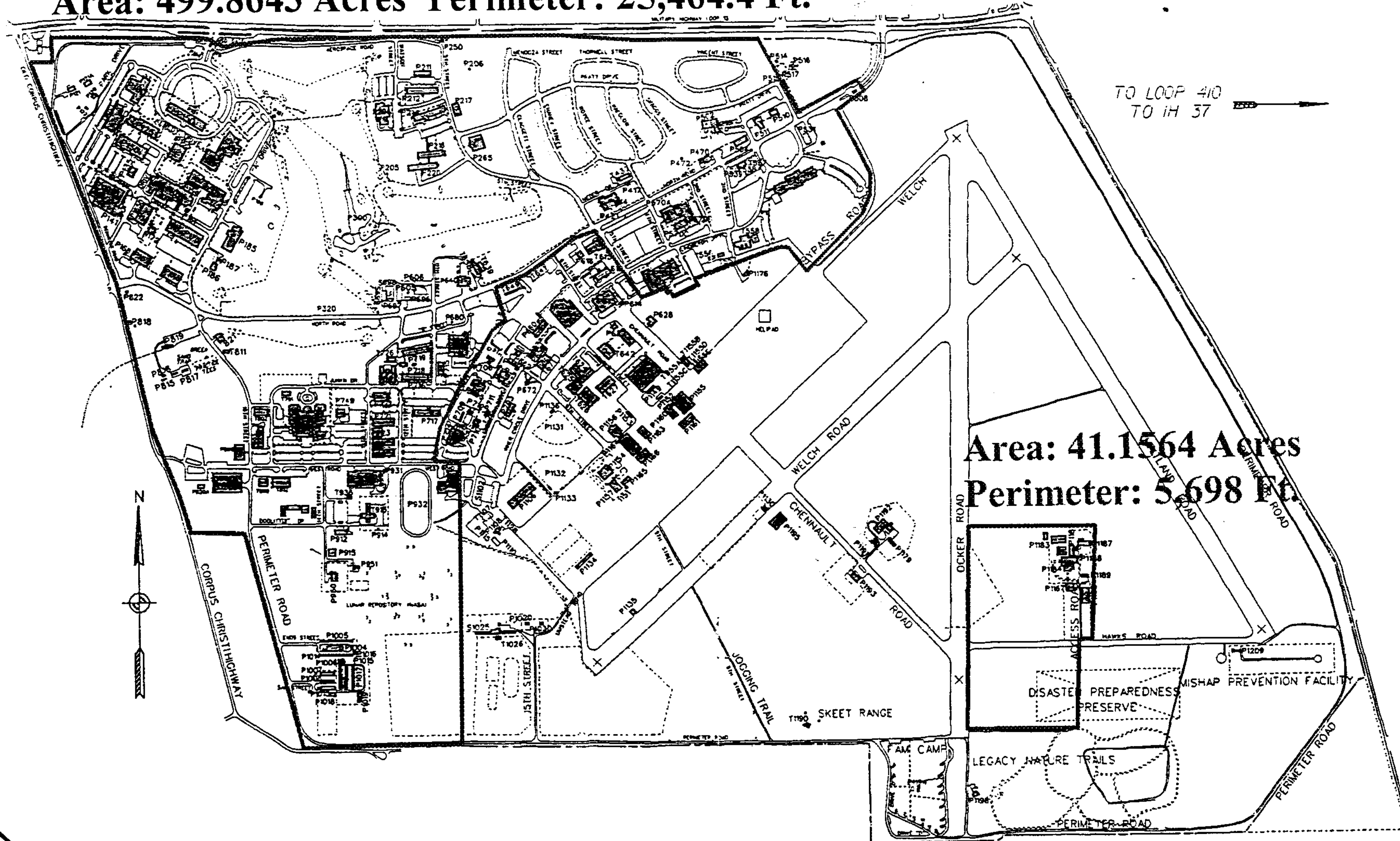
Brooks AFB Cantonment
Lackland AFB Annex

Area: 499.8643 Acres Perimeter: 25,464.4 Ft.



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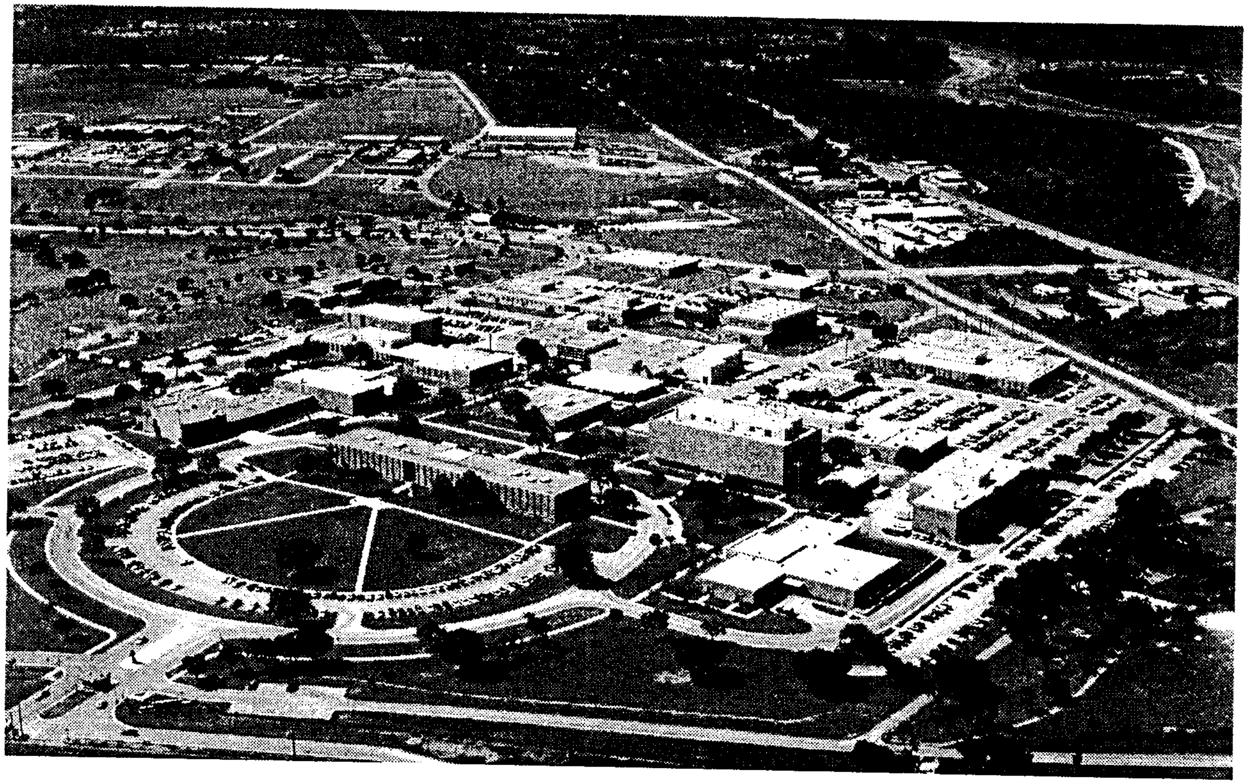
HUMAN SYSTEMS CENTER
AIR FORCE MATERIEL COMMAND



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HSC/PAS/GENTILE/AY

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AIR FORCE VISION

Air Force <u>PEOPLE</u> Building the World's Most Respected Air and Space Force ... Global Power and Reach for America.

Mission ***Systems*** ***People***

~~AL/CC2/FHS 17~~
HSC/PAS/GENTILE/AY95

HSC PURPOSE

THE HUMAN SYSTEMS CENTER TEAM WORKS WITH ITS CUSTOMERS TO ENHANCE OUR WARFIGHTER'S COMPETITIVE EDGE BY PROVIDING SUPERIOR HUMAN CENTERED TECHNOLOGY, SYSTEMS, EDUCATION AND SUPPORT. *WE ARE THE SYSTEM'S INDEPENDENT ADVOCATE FOR THE HUMAN IN DESIGN, DEPLOYMENT AND OPERATIONS OF AEROSPACE SYSTEMS*

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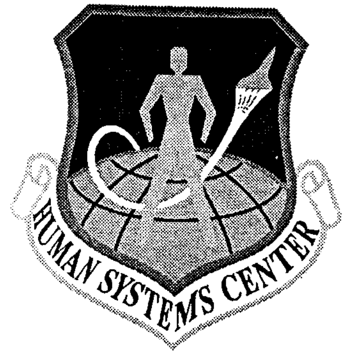
HSC/PAS/GENTILE/AY95



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HSC/PAS/GENTILE/AY 95

PRODUCT CENTER BASE DESCRIPTION BROOKS AFB

- MAJOR UNITS
  - HUMAN SYSTEMS CENTER TO INCLUDE:
    - ARMSTRONG LAB
    - USAF SCHOOL OF AEROSPACE MEDICINE
    - HUMAN SYSTEMS PROGRAM OFFICE
    - AIR BASE GROUP
      - SYSTEMS ACQUISITION SCHOOL
  - AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
  - AIR FORCE MEDICAL SUPPORT AGENCY

~~AL/CC/EHS~~
HSC/PAS/GENTILE/MAY 95

PRODUCT CENTER BASE DESCRIPTION BROOKS AFB (CONT)

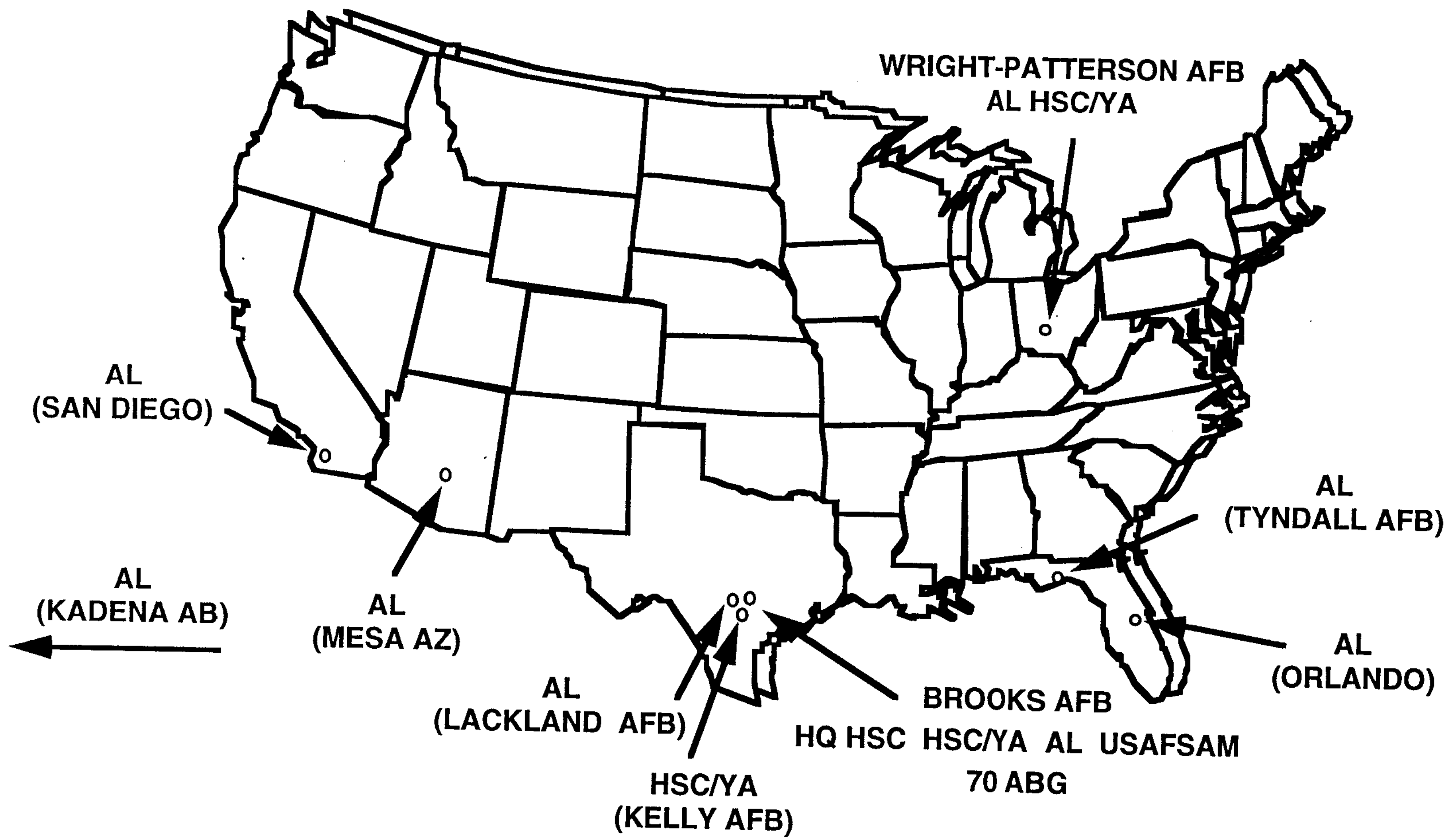
- PRODUCT LINES - RESEARCH RELATED TO HUMAN SYSTEMS
    - CREW SYSTEMS INTEGRATION
    - HUMAN RESOURCES
    - AEROSPACE MEDICINE
    - OCCUPATIONAL/ENVIRONMENTAL HEALTH
    - EDUCATION/FORCE READINESS
    - MEDICAL/ENVIRONMENTAL SAMPLE ANALYSIS SERVICE
    - ENVIRONMENTAL COMPLIANCE SERVICES

FY95 HSC SNAPSHOT

- 3,249 People Managing $608 Million Annually
- 962 Scientists & Engineers
    - 400 Published Articles • 27 Patents, Inventions, Disclosures
    - 71 Focused Technology Areas
- 2,215 Degrees Held
    - 242 Doctoral • 570 Masters • 1,403 Bachelors
- 400 Acquisition Professionals
    - 40+ Development / Production Programs
    - 7,000+ Sustainment Items
- 128 Education / Training Instructors
    - 61 Aerospace Medicine Courses Graduating 4,768 Students
    - 8 System Acquisition Courses Graduating 1,385 Students

HSC/PAS/GENTILE/AY 95

HSC ORGANIZATIONS



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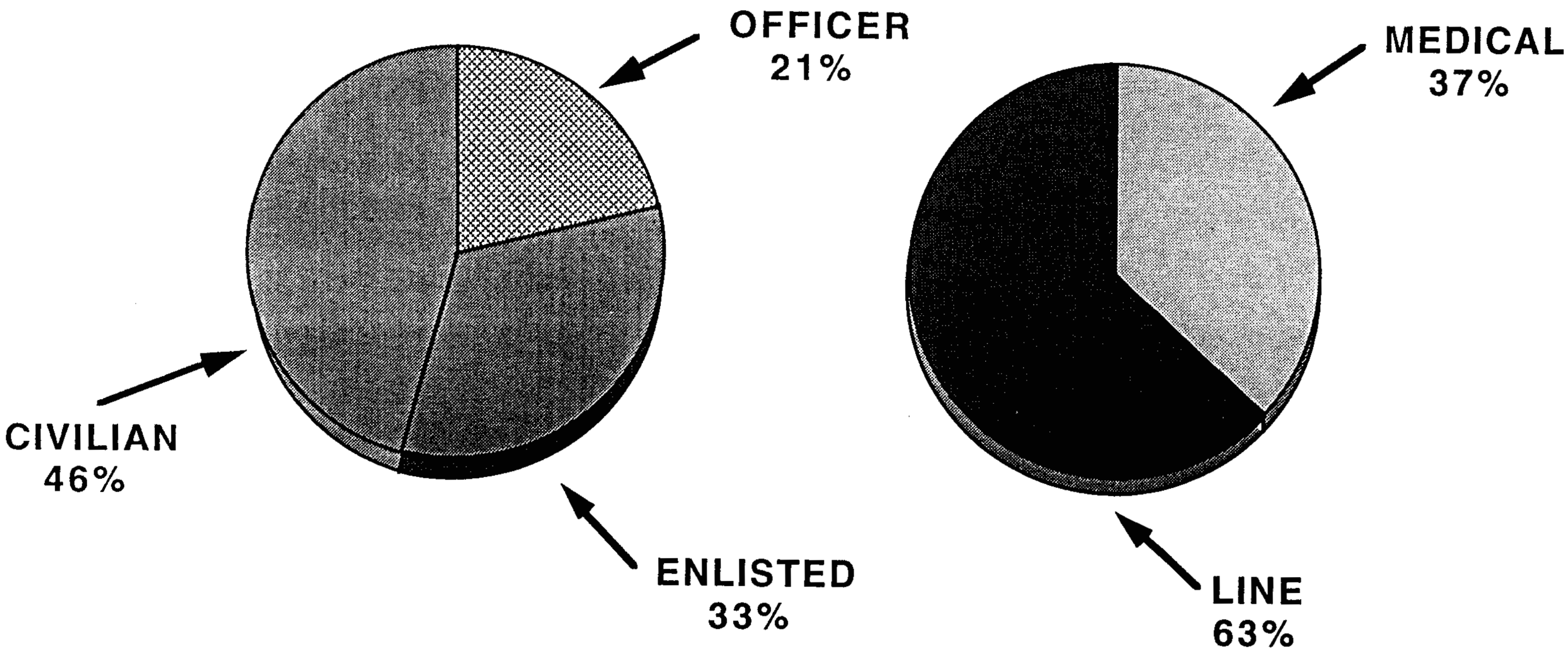
HSC PERSONNEL

TOTAL = 3000+



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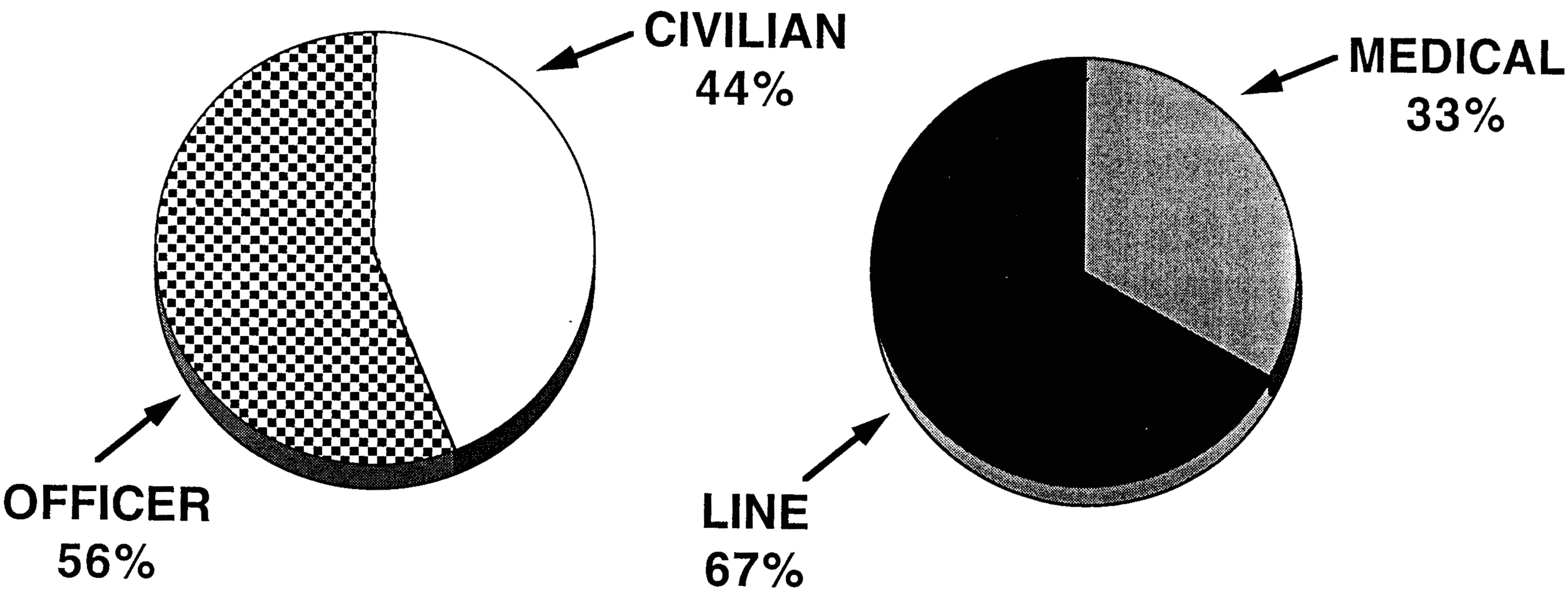
HSC SCIENTIFIC & ENGINEERING PERSONNEL

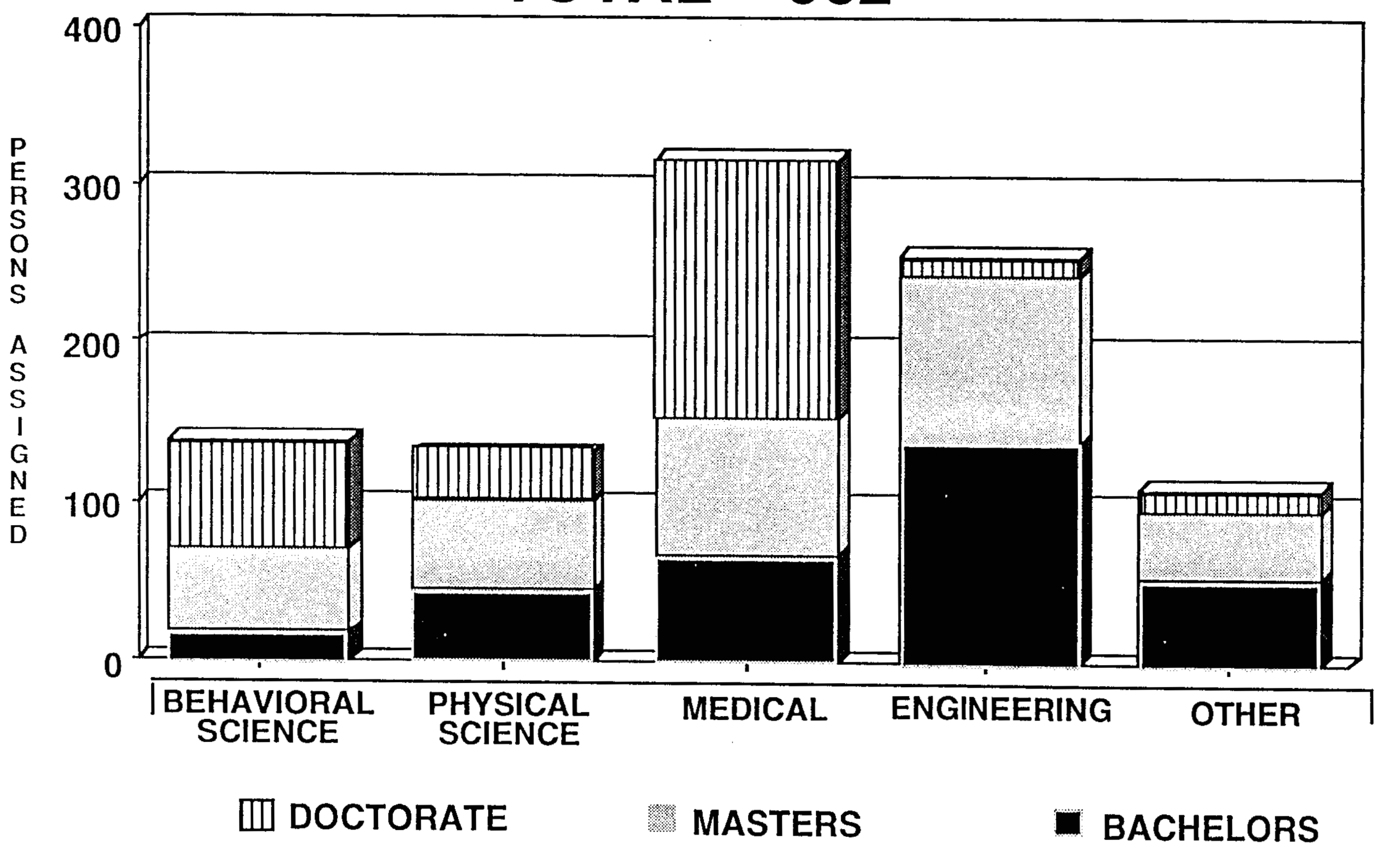
TOTAL = 962



HSC/PAS/

HSC SCIENTIFIC & ENGINEERING PERSONNEL

TOTAL = 962



HSC/PAS/GENTILE/AY95/ ~~23~~ 11

HUMAN SYSTEMS TECHNOLOGY

- DOD PERVASIVE, CORE TECHNOLOGY
  - REQUIRES IN-DEPTH FAMILIARITY WITH SERVICE OPERATIONS
  - REQUIRES TIGHT USER INTERFACE
- OFTEN MILITARILY UNIQUE, WITHOUT CIVILIAN COUNTERPART
- ENDORSED TO CSAF BY AFSAB 1994 SUMMER STUDY

HUMAN SYSTEMS TECHNOLOGY WILL BE OF PARTICULAR VALUE FOR THE FUTURE

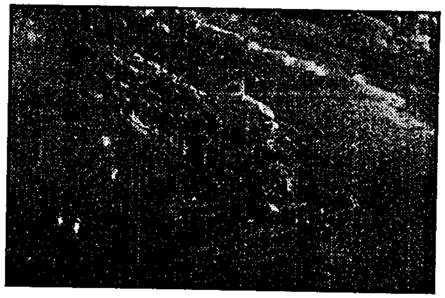
- FEWER NEW WEAPONS; AF MUST EXTEND DEMANDS ON CURRENT SYSTEMS AND CREW
- COMPLEX FUTURE WEAPONS SYSTEMS WILL REQUIRE IMPROVED DATA FUSION BY AIRCREW
- NIGHT AND ALL-WEATHER OPS WILL INCREASE DEMANDS ON CREWMEMBERS
- TRAINING AND SELECTION WILL BECOME EVEN MORE CRITICAL
- HUMAN SYSTEMS TECHNOLOGY = LEVER TO MAINTAIN FORCE EFFECTIVENESS DURING DOWNSIZING
- ENVIRONMENTAL LAWS IMPACT AIR BASE OPS, BASE CLOSURES, WASTE STREAMS

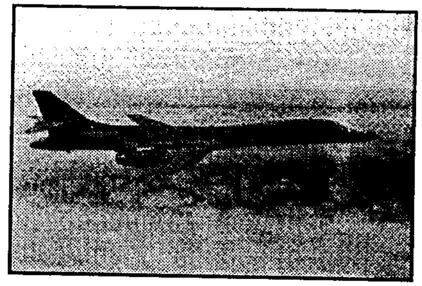
~~AL/CC2/FH5~~
HSC/PAS/GENTILE/FH/95/13

HSC IS LOGICAL ORGANIZATION TO BE FOCAL POINT FOR ALL HUMAN SYSTEMS TECHNOLOGY

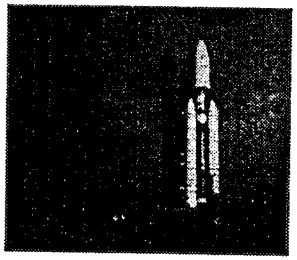
- SINGLE MANAGER, ADVOCATE TO PREVENT FRAGMENTATION / ATTRITION
- AL IS ONLY LAB COORDINATING THROUGH MORE THAN TWO RELIANCE PANELS
- 1300 ACRES AT BROOKS AFB FOR FUTURE EXPANSION
- DOWNSIZING OPENS UP ADDITIONAL ROOM FOR FURTHER COLLOCATIONS
- NEW FACILITIES UNDER CONSTRUCTION AT BROOKS AFB
    - USAFSAM ACADEMIC COMPLEX
    - DIRECTED ENERGY LABORATORY
    - AFCEE BUILDING

AIR FORCE MATERIEL COMMAND

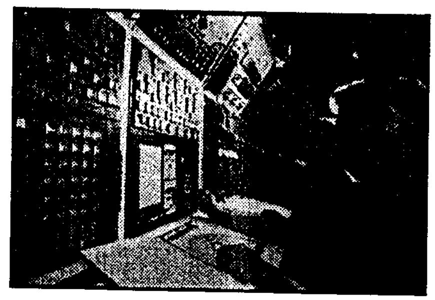




THERE ARE NO



UNMANNED SYSTEMS



~~AL/CC2/FH5~~ ~~25~~
HSC/PAS/GENTILE/AY 95/15

HSC'S MISSION

THE WARFIGHTER

AIR STAFF

PROGRAM EXECUTIVE OFFICER

OTHER PRODUCT CENTERS

TECHNOLOGY EXECUTIVE OFFICER

INDUSTRY

DELIVER KNOWLEDGE & SKILLS

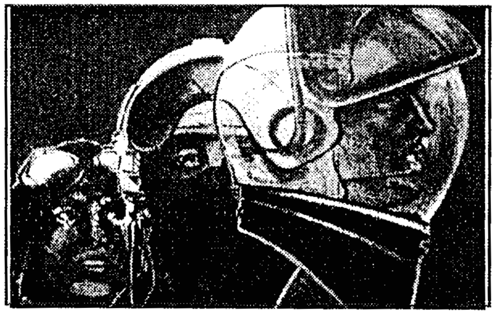
SUPPORT OPERATIONAL SYSTEMS

DELIVER HUMAN SYSTEMS

SUPPORT WEAPON SYSTEMS DEVELOPMENT

DELIVER HUMAN-CENTERED SCIENCE & TECHNOLOGY

DELIVER HUMAN-CENTERED SCIENCE & TECHNOLOGY THAT ARE



- OF SUPERIOR QUALITY
- OPERATIONALLY RELEVANT
- INNOVATIVE
- RAPIDLY TRANSITIONED TO SYSTEM

ARMSTRONG LABORATORY TECHNOLOGY TRANSITION TO HUMAN SYSTEMS PROGRAM OFFICE

- COMBINED ADVANCED TECHNOLOGY ENHANCED DESIGN G-ENSEMBLE (COMBAT EDGE)
- NIGHT VISION SYSTEM
- DISPOSABLE EYE / RESPIRATORY PROTECTION SYSTEM
- THERMAL FLASHBLINDNESS PROTECTION DEVICE
- AIRCRAFT MISHAP PREVENTION SYSTEM
- RAPID OPTICAL SCREENING TOOL (ROST)
- ACTIVE NOISE REDUCTION
- MAINTENANCE SKILLS TUTOR
- CIVIL RESERVE AIR FLEET AEROMEDICAL EVACUATION SHIPSETS
- ADVANCED TECHNOLOGY ANTI-G SUIT (ATAGS)
- MICRO COMPUTER INTELLIGENCE FOR TECHNICAL TRAINING (MITT)

INTEGRATION OF RESEARCH AND EDUCATION BETWEEN AL AND USAFSAM

- DEVELOPMENT OF THE ADVANCED SPATIAL DISORIENTATION DEMONSTRATOR
  - TRAINING PROTOCOLS FOR RECOGNITION OF SD AND RECOVERY TECHNIQUES
    - DEVELOPED FOR ACC AND AETC PILOTS
    - USAFSAM LEADS AND AL SUPPORTS
  - DEVELOPMENT OF REALISTIC FLIGHT SIMULATIONS
    - AL LEADS AND USAFSAM SUPPORTS
- COOPERATION IN RESEARCH AND EDUCATION MISSIONS - THE UNIVERSITY MODEL
  - USAFSAM EDUCATORS PARTICIPATE IN RESEARCH MISSION OF AL
  - AL SCIENTISTS AND ENGINEERS SERVE AS FACULTY MEMBERS IN USAFSAM

AL TIGHTLY INTEGRATED WITH SAN ANTONIO MILITARY COMMUNITY

- USAF SCHOOL OF AEROSPACE MEDICINE (SAM)
  - JOINT PROJECTS AND PERSONNEL EXCHANGES
- AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE (AFCEE)
  - RECIPIENT AND BROKER OF AL ENVIRONMENTAL TECHNOLOGIES
- HUMAN SYSTEMS PROGRAM OFFICE
  - TRANSITION HUMAN-CENTERED TECHNOLOGY
- AIR EDUCATION AND TRAINING COMMAND (AETC)
  - REQUIREMENTS, EVALUATIONS AND SUBJECTS FOR AIRCREW TRAINING R&D
- AIR FORCE MILITARY PERSONNEL CENTER
  - REPOSITORY FOR MPC DATABASE
- LACKLAND AFB
  - FACILITIES AND SUBJECTS FOR TRAINING AND SELECTION RESEARCH
- KELLY AFB
  - BIOREMEDIATION TEST SITE

~~AL/CC2/FHS 19~~
HSC/PAS/GENTILE/AY95/20

USAF SCHOOL OF AEROSPACE MEDICINE

(USAFSAM)

PROVIDES TRAINING, EDUCATION, AND CONSULTATION IN THE AREAS OF HUMAN PERFORMANCE ENHANCEMENT, CONTINGENCY MEDICAL OPERATIONS, OCCUPATIONAL HEALTH, DISEASE PREVENTION, ENVIRONMENTAL QUALITY, AND AEROMEDICAL EVACUATION

~~AL/CC2/FHS 18~~
HSC/PAS/GENTILE/AY95/21

USAFSAM

- INTERNATIONALLY RECOGNIZED
- 5000+ STUDENTS PER YEAR
  - AEROSPACE MEDICINE
  - AEROSPACE NURSING
  - AEROSPACE PHYSIOLOGY
  - PUBLIC HEALTH
  - BIOENVIRONMENTAL ENGINEERING
- ENTRY LEVEL THROUGH 4TH YEAR POST M.D.
  - USAF, DOD, AND ALLIED NATIONS

~~AL/CC2/FH5 14~~
HSC/PAS/GENTILE/AY95/22

USAFSAM

- HIGHLY SYNERGISTIC RELATIONSHIP WITH AL AND YA
    - 30% OF USAFSAM PODIUM HOURS CONDUCTED BY AL AND YA SUBJECT MATTER EXPERTS
    - AL PROVIDES ESSENTIAL RESEARCH BASE FOR ADVANCED USAFSAM STUDENTS
    - USAFSAM STAFF PROVIDES OPERATIONAL INSIGHT FOR RESEARCHERS, PROGRAM MANAGERS

HSC/PAS/GENTILE/AY95/23

WE ARE THE HUMAN SYSTEMS CENTER

THE HUMAN IS THE HEART OF AEROSPACE
SYSTEMS AND OPERATIONS

THERE ARE NO UNMANNED SYSTEMS

~~AL/CC2/FH5 27~~
HSC/PAS/GENTILE/AY95/
27

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HUMAN SYSTEMS CENTER
BROOKS AIR FORCE BASE, TEXAS

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BIOGRAPHY

UNITED STATES AIR FORCE

Secretary of the Air Force
Office of Public Affairs
Washington, D.C. 20330-1690

BRIGADIER GENERAL (DR.) ROBERT P. BELIHAR

Brigadier General (Dr.) Robert P. Belihar is commander of the Human Systems Center (HSC), Air Force Materiel Command, Brooks Air Force Base, Texas. The organization is the Air Force home of science and technology related to the integration of human factors in Air Force systems. Recognizing that people are the key to all Air Force endeavors, HSC is the product center focusing on human-centered research, development, acquisition and aeromedical operational support.

The general was born April 26, 1941, in Santa Monica, Calif., and graduated from Spanish Fork (Utah) High School in 1959. He graduated from Brigham Young University, Utah, receiving a bachelor of science degree in 1963 and a master of science degree in 1968. He earned his doctor of medicine degree from the University of Utah, Salt Lake City, in 1969. He completed Air War College in 1982 and Capstone in 1994.

General Belihar is married to the former Anita Louise Carroll of Jacksonville, N. C. They have three daughters: Jennifer Louise, Lori Lyn and Julia Christine.

EDUCATION:

1963	Bachelor of science degree in zoology, Brigham Young University, Utah
1968	Master of science degree in zoology, Brigham Young University, Utah
1969	Doctor of medicine degree, University of Utah
1970	Aerospace Medicine Primary Course, USAF School of Medicine, Brooks Air Force Base,Texas
1974	Ophthalmology residency, Duke University, North Carolina and University of Tennessee
1982	Air War College, Maxwell Air Force Base, Ala.
1982	Master of public health degree, University of Texas
1983	Aerospace Medicine Residency, USAF School of Medicine, Brooks Air Force Base, Texas

ASSIGNMENTS:

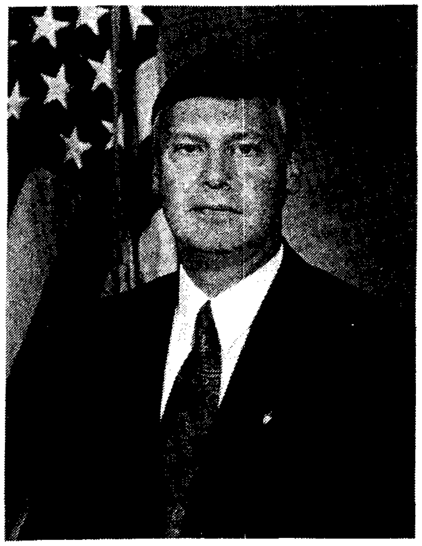
1. July 1970 - May 1971, squadron flight surgeon, Homestead Air Force Base, Fla.
2. May 1971 - June 1974, chief of service, aerospace medicine, USAF Hospital, Zweibrucken Air Base, West Germany
3. January 1977 - November 1978, chief of service, aerospace medicine, USAF Hospital, Myrtle Beach, S.C.
4. November 1978 - October 1981, ophthalmologist and flight surgeon, USAF Hospital, Luke Air Force Base, Ariz.
5. July 1983 - August 1984, chief of service, aerospace medicine, USAF Hospital, Edwards Air Force Base, Calif.
6. August 1984 - August 1986, hospital commander, USAF Hospital, Edwards Air Force Base, Calif.
7. August 1986 - October 1988, chief, aeromedical requirements, and chief, aerospace medicine, Headquarters Tactical Air Command, Langley Air Force Base, Va.

United States Air Force

BIOGRAPHY

Office of Public Affairs, Human Systems Center, 2510 Kennedy Circle, Suite 1,
Brooks AFB TX 78235-5120 Phone (210) 536-3234 Fax (210) 536-3235

MR. GARY M. GRANN



Gary M. Grann is a member of the Senior Executive Service and the executive director for the Human Systems Center (HSC), Air Force Materiel Command, Brooks Air Force Base. As such, he is second in command of an organization comprised of more than 3000 military and civil service personnel with an annual budget exceeding $300 million. Recognizing that people are the key to all Air Force endeavors, HSC is the product center focusing on human-centered research, development, acquisition, and aero-medical operational support.

In 1963, he was commissioned a second lieutenant in the Air Force and served four years as a test engineer at the Air Proving Ground Center, Eglin Air Force Base, Florida. Mr. Grann began his civilian career in April 1971 and has held positions of increasing responsibility in three product centers, an Air Force laboratory and two test organizations. He has also served two assignments in Europe to include being named the senior United States representative to the NATO Air Command and Control System Team. In June 1984, he was promoted into the Scientific and Professional Executive Corps (ST) and assigned to Hanscom Air Force Base where he served in several positions to include senior technical advisor to the commander, Electronic Systems Center. Mr. Grann entered the Senior Executive Service in July 1993. He is a graduate of the Harvard University Senior Executive Fellows program and a 1990 graduate of the Federal Executive Institute. He completed the Program Management Course at the Defense Systems Management College in 1993 and is certified Level III in Program Management and Planning, Research, Development, and Engineering.

Mr. Grann is married to the former Jimmie Walley of Hattiesburg, Miss. They have two children, Eric and Michelle.

EDUCATION:

1963	Bachelor of science degree in physics and mathematics, University of Minnesota
1968	Master's degree in mathematical statistics, Florida State University
1986	Senior Executive Fellows, Harvard University
1990	Federal Executive Institute
1993	Program Management Course, Defense Systems Management College

ASSIGNMENTS:

1. October 1963- October 1967, entered active duty as a Project Test Engineer, Air Proving Ground Center, Eglin Air Force Base, Fla.
2. October 1967- August 1968, graduate student, Florida State University, Tallahassee, Fla.
3. August 1968 - April 1971, Project Scientist, Booz Allen Applied Research, Ft Walton Beach, Fla.
4. April 1971 - February 1972, Research Analyst, Air Force Armament Laboratory, Eglin Air Force Base, Fla.
5. February 1972 - September 1976, Operations Research Analyst, United States Air Force Europe, Ramstein Air Base, Germany.
6. September 1977 - May 1979, Supervisory Operations Research Analyst, Tactical Air Warfare Center, Eglin Air Force Base, Fla.
7. May 1979 - November 1981, Technical Director, Electronic Systems Division - Europe, Kapaun Air Station, Germany.
8. November 1981 - June 1984, Head, Systems Design, NATO Air Command and Control System Team, Brussels, Belgium.
9. June 1984 - July 1987, selected for Scientific and Professional Executive Corps (ST) and assigned as the Technical Director, Deputy for Development Plans, Electronic Systems Division, Hanscom Air Force Base, Mass.
10. August 1987 - July 1990, Technical Director and Director of Engineering for the Advanced Technology Systems Program Office, Electronic Systems Division, Hanscom Air Force Base, Mass.
11. July 1990 - July 1993, Senior Technical Advisor to the Commander, Electronic Systems Center, Hanscom Air Force Base, Mass.
12. July 1993 - October 1994, selected for Senior Executive Service with assignment as Director, Plans and Advanced Programs, Electronic Systems Center, Hanscom Air Force Base, Mass.
13. October 1994 - Present, Executive Director, Human Systems Center, Brooks Air Force Base, Texas.

MAJOR AWARDS AND DECORATIONS:

Air Force Commendation Medal
Civilian Meritorious Service Award
Technical/Professional Employee of the Year, Boston Federal Executive Board
Organizational Quality Improvement Prototype Award
Scientific/Professional (ST) Outstanding Performance with Award, 1985-1993

United States Air Force

FACT SHEET

Office of Public Affairs, Human Systems Center, 2510 Kennedy Circle, Suite 1, Brooks AFB TX 78235-5120 Phone (210) 536-3234 Fax (210) 536-3235

HUMAN SYSTEMS CENTER

MISSION

The Human Systems Center of Air Force Materiel Command, headquartered at Brooks Air Force Base, Texas, is the Air Force advocate for integrating and maintaining the human in Air Force systems and operations. People are the key to all Air Force operations. HSC is the systems-independent product center for human-centered research, development, acquisition and specialized operational support.

Its mission is to protect and enhance human capabilities and human-systems performance with a scope of impact ranging from the individual to combatant command forces including DOD and Allied Nations Forces. The Armstrong Laboratory, the USAF School of Aerospace Medicine, the HSC Program Office (YA), the 70th Medical Squadron and an air base group are the major units of HSC.

HISTORY

HSC's origins go back to Jan. 19, 1918, when the Medical Research Laboratory was formed at Hazelhurst Field, N.Y. In 1922, this Laboratory was redesignated the School of Aviation Medicine, and four years later it moved to Brooks Field which was a center for primary flight training. Both organizations moved to Randolph Field in October 1931. The school moved back to Brooks during the summer of 1959 and the base became the headquarters for the Aerospace Medical Center the same year.

The Center represented the initial step in placing the management of aerospace medical research, education and clinical medicine under one command. Both the school and center were reassigned from Air Training Command to Air Force Systems Command in November 1961 and assigned to the new organization, Aerospace Medical Division (now HSC).

(Current as of March 1995)

On Nov. 21, 1963, President John F. Kennedy dedicated four new buildings of USAFSAM in the complex that housed the Aerospace Medical Division. This was his last official act before his assassination in Dallas the following day.

In 1986, the Department of Defense began streamlining its organization as a result of the Packard Commission recommendations. This division's acquisition mission emphasized its human-centered technologies. It restructured its functional areas and was renamed the Human Systems Division on Feb. 6, 1987.

In December 1990, the Air Force Systems Command underwent a major restructuring which consolidated 16 laboratories nationwide into four. Brooks Air Force Base and the Human Systems Division became home of one of the "super labs." The new lab, named the Armstrong Laboratory, is a world-class center in science and technology for protecting the human in Air Force systems.

On July 1, 1992, the Human Systems Division was renamed the Human Systems Center as part of the structuring of the new Air Force Materiel Command. The command was activated July 1, 1992, when the Air Force Logistics Command and Air Force Systems Command were integrated.

ORGANIZATIONS

The Human Systems Center headquarters supports its subordinate organizations with administration, command and control, and logistics.

U.S. Air Force School of Aerospace Medicine

As the center for aerospace medicine education, the USAF School of Aerospace Medicine is the major provider of educational programs involving aviation, space, and environmental medicine for Air Force, DOD, and Allied Nations personnel. The programs span entry level through graduate medical education in all disciplines encompassed in the aerospace medicine specialty.

70th School Squadron

The 70th Training Squadron advances the education of acquisition professionals to support and sustain all Air Force weapons systems. About 1,500 students are trained annually.

Human Systems Center Program Office

The program office is responsible for the engineering and manufacturing development, production, evolution and sustainment of life support, chemical defense, aeromedical, human resource, and operational analysis systems, and the design and test of Air Force uniforms. The program office demonstrates technology concepts in prototype systems to reduce technical, cost, and schedule risk, and to accelerate the transition arm of the Human Systems Center.

It is responsible for proper execution of engineering and manufacturing development and production programs and coordinates acquisition efforts with other agencies and the using MAJCOMs. The program office is also responsible for the Human Systems Center staff functional work in the areas of engineering, manufacturing/quality assurance, configuration/data management, test and evaluation, and acquisition logistics.

70th Air Base Group

The 70th Air Base Group operates and maintains Brooks Air Force Base in support of HSC and tenant units.

The Armstrong Laboratory

The Armstrong Laboratory, as one of the four Air Force "Super Laboratories," is the Air Force's center of excellence for human-centered science and technology. The laboratory provides the science and technology base and the direct operational support needed to enhance human performance in Air Force systems and operations. The research, development, and support activities of the laboratory address current and future needs in the areas of human resources, crew systems, aerospace medicine, and occupational and environmental health to enhance crew protection and performance, training and logistics, and force management, health and safety.

70th Medical Squadron

The 70th Medical Squadron provides personalized outpatient medical and dental care for the Brooks Air force Base community in a total quality environment. Services include primary care, aerospace medicine, optometry, military health, pharmacy, radiology, immunology, military public health, bioenvironmental engineering, and clinical laboratory. Approximately 25,000 patients per year are treated here.

The 70th Medical Squadron was awarded the Air Force Outstanding Unit Award in 1993, the AFMC Outstanding Clinic, James L. Borders Award in 1993, the Air Training Command Award for Significant Achievement in the Prevention of Ground Mishaps, and the Joint Accreditation of Healthcare Organizations with Commendation award.

United States Air Force

FACT SHEET

Office of Public Affairs, Human Systems Center, 2510 Kennedy Circle, Suite 1,
Brooks AFB TX 78235-5120 Phone (210) 536-3234 Fax (210) 536-3235

ARMSTRONG LABORATORY

MISSION

The Armstrong Laboratory plans, manages, and conducts research, exploratory and advanced development, and specialized operational support, all focused on the readiness, maintenance, protection and enhancement of human capabilities. The laboratory is an integral element of the Human Systems Center (HSC), the prime systems-independent advocate for the human-centered concerns in Air Force weapon systems design, development and deployment. Laboratory research and development efforts complement, are coordinated with, and link HSC programs in development planning and human systems acquisition.

Laboratory products assure human system performance at individual, crew, team and force levels, enabling the Air Force to meet current and future operational requirements in the functional areas of aerospace medicine, disease prevention and health services assessment, crew systems, human resources, and occupational and environmental health. Highlighting man as the ultimate enabling factor in Air Force weapon systems, the Armstrong Laboratory sponsors and conducts research and development in the fields of biodynamics, biocommunications, toxic hazards, radiation/directed energy bioeffects, aeromedical selection/retention, human engineering, crew protection/life support, logistics and human factors, force acquisition and management, instructional strategies, job skill development and retention, and training systems/simulator developments.

Responding to customer needs and maintaining our superiority in the human systems technology area, the laboratory builds the technological framework upon which systems acquisition excellence is based.

The laboratory consists of a command section, plans function, operations and support, financial management, contracting staff, and six functional technical directorates. The functional directorates are interdisciplinary entities structures to address Air Force future capability needs in aerospace medicine, disease prevention and health services assessment, environics, crew systems, human resources, and occupational and environmental health.

The Plans Directorate is responsible for program and process analysis and integration, planning and decision support for the Armstrong Laboratory's scientific, technical, and operational support programs. This Directorate reviews mission and

(Current as of March 1995)

planning documents as well as systems under development to identify relevant human systems technology needs and objectives which meet user's needs. The plans directorate coordinates dual use (defense conversion) activities and develops advocacy products for the Armstrong Laboratory.

The Aerospace Medicine Directorate conducts research, development, and operational support applying medical principles to the selection, retention, and maintenance of aircrew in Air Force operations. It is responsible for monitoring various disease study groups in the flying population and maintaining associated databases. Findings from these studies support the early detection of disease in this critical Air Force personnel resource, enabling more successful treatment and return to the cockpit where flight safety is not compromised. Within this directorate are specialized laboratory programs in epidemiologic research and field support, dental service equipment evaluation, hyperbaric medicine, and certified substance abuse testing.

The Office for Prevention and Health Services Assessment enhances the readiness of the fighting force through effective disease/injury prevention, and health promotion programs. This office provides operational commanders and managers of health programs with improved capabilities to make evidence-based decisions on fitness programs, dietary habits, and lifestyle change recommendations. By focusing preventive medicine programs on Air Force specific issues, this office provides capability to measure the impact of specialized programs on the airman, squadron, mission, wing, and Air Force community at large.

The Occupational and Environmental Health Directorate assesses risks to personnel from exposure to hazardous materials, noise, electromagnetic radiation, and occupational processes in Air Force operations; and conducts research and development to reduce such risks. The Directorate works with all echelons of USAF commanders to acquire, operate, maintain, and dispose of weapons systems within the guidelines of environmental law and regulation. Through broad field consultation responsibilities, it captures and maintains an extensive data base of observed occupational illnesses and environmental exposures. It studies interactions between environmental hazards, USAF operations and personnel, and applies the resulting knowledge to mitigate impacts on health and maintain technological superiority concerning the biological effects of radiation/directed energy.

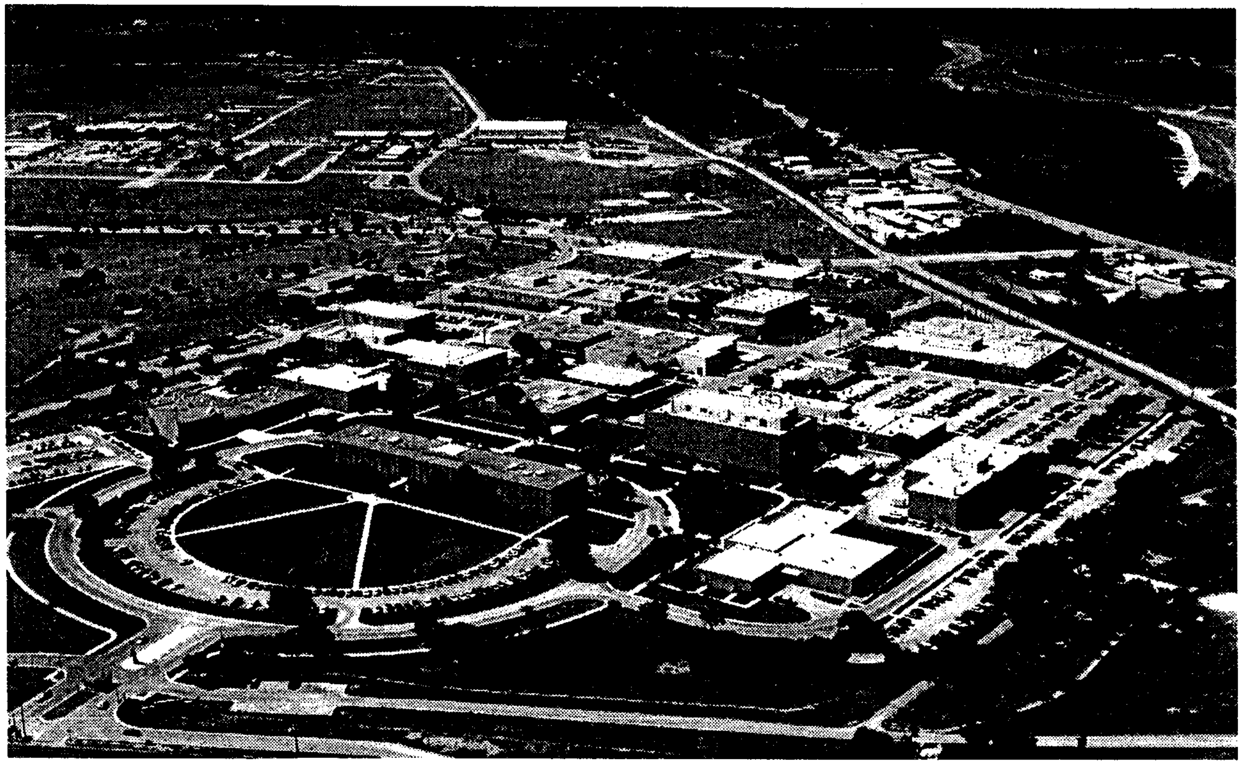
The Crew Systems Directorate conducts research, development, and field support to integrate human operators with weapon systems and to optimize human combat performance, protection, and survivability.. It researches human physical, physiological, and behavioral characteristics and stress tolerance to develop permissible crew exposure limits, crew station and equipment design criteria, and protective countermeasures. The Directorate develops design tools and prototype crew stations and equipment to provide a competitive advantage to military combat crews. It manages laboratory programs in anthropometry, sustained acceleration, workload analysis, helmet mounted systems, bioacoustics and biocommunications, biodynamic modeling, escape systems, life support, chemical and biological defense, aeromedical evacuation equipment, high altitude protection, sustained operations, spatial orientation countermeasures, and crew vulnerability reduction. It provides field support to solve related problems encountered in operational systems.

The Human Resources Directorate performs scientific research and develops technologies and methods to acquire, classify, train, integrate, manage, and retain Air Force human resources for maximum combat effectiveness. Human resources studies seek to match people with the most appropriate jobs, to enhance productivity through understanding the elements of job performance, to model and predict force-wide career flow options, and to analyze manpower, personnel and training components to reduce weapon systems life cycle costs. It develops training devices, systems and instructional strategies with particular emphasis on aircrew skills enhancement. It develops methods, processes, and tools to facilitate early incorporation of supportability considerations in the acquisition process, thereby improving weapon systems affordability and sustainability as well as by reducing operational resource requirements. Also, it develops methods to assess aircraft battle damage, thus improving combat logistics and repair performance.

The Environics Directorate supports the Air Force mission by reducing the costs of cleaning up past waste sites while assuring, through compliance, the completion of critical wartime and peacetime flying. Environmental quality efforts at Tyndall Air Force Base, Fla., center on low-cost, highly effective ways to prevent environmental problems and to restore existing facilities. The Directorate has state-of-the-art analytical laboratories, staffed by engineers, chemists, microbiologists, other scientists, and technicians. The extended research base that supports this laboratory includes investigators from colleges and universities throughout the United States as well as cooperating research partners in private institutions, industry and other federal laboratories.

As part of its special relationship with the U.S. Air Force School of Aerospace Medicine, the Armstrong Laboratory provides instructional expertise and access to its vast aeromedical databases, information resources and laboratory facilities.

HUMAN SYSTEMS CENTER
AIR FORCE MATERIEL COMMAND



AIR FORCE VISION

Air Force PEOPLE Building the World's Most Respected Air and Space Force ... Global Power and Reach for America.

Mission ← ***Systems*** ← ***People***

HSC PURPOSE

THE HUMAN SYSTEMS CENTER TEAM WORKS WITH ITS CUSTOMERS TO ENHANCE OUR WARFIGHTER'S COMPETITIVE EDGE BY PROVIDING SUPERIOR HUMAN CENTERED TECHNOLOGY, SYSTEMS, EDUCATION AND SUPPORT. *WE ARE THE SYSTEM'S INDEPENDENT ADVOCATE FOR THE HUMAN IN DESIGN, DEPLOYMENT AND OPERATIONS OF AEROSPACE SYSTEMS*

PRODUCT CENTER BASE DESCRIPTION BROOKS AFB

- MAJOR UNITS
  - HUMAN SYSTEMS CENTER TO INCLUDE:
    - ARMSTRONG LAB
    - USAF SCHOOL OF AEROSPACE MEDICINE
    - HUMAN SYSTEMS PROGRAM OFFICE
    - AIR BASE GROUP
      - SYSTEMS ACQUISITION SCHOOL
  - AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
  - AIR FORCE MEDICAL SUPPORT AGENCY

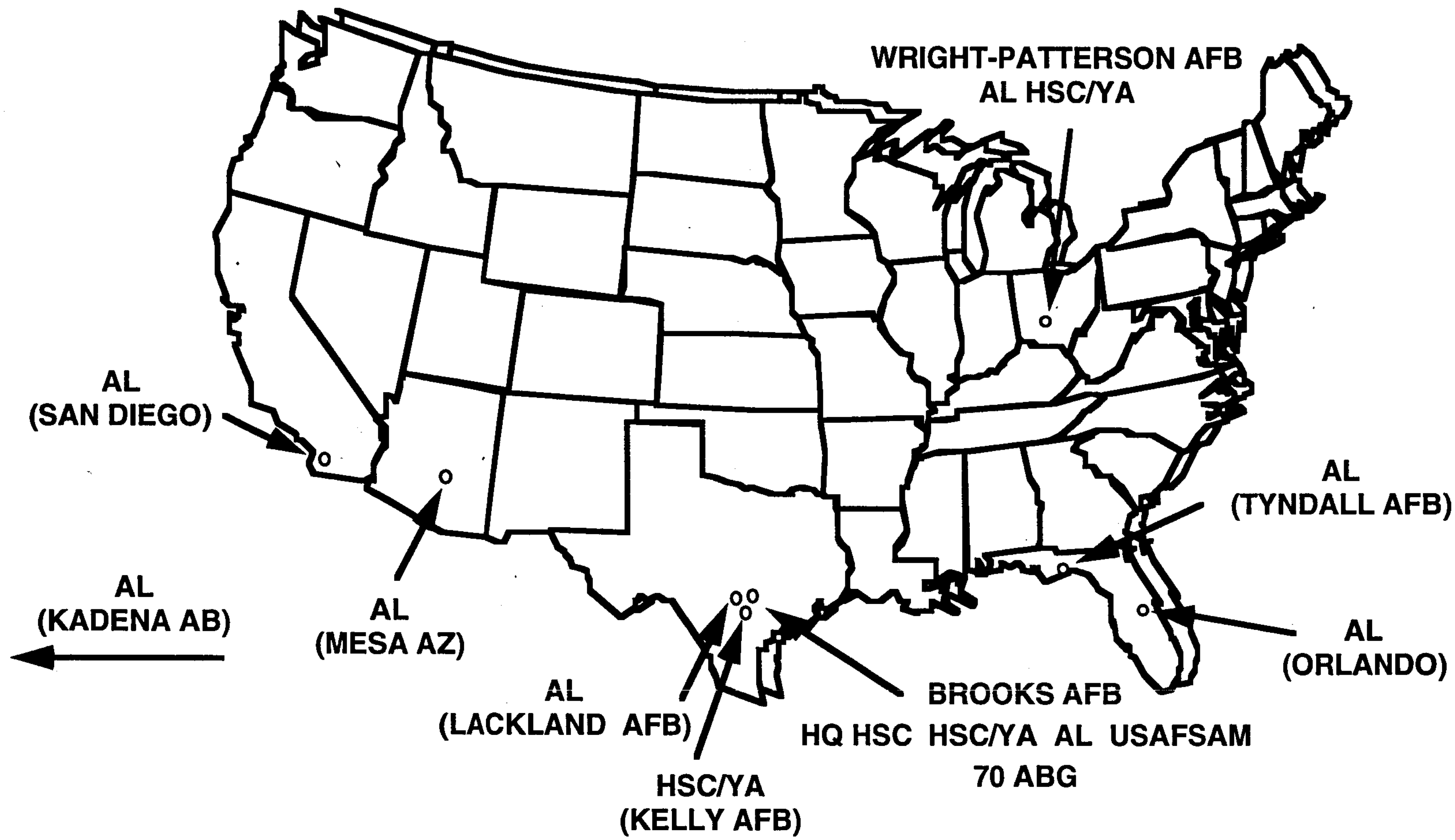
PRODUCT CENTER BASE DESCRIPTION BROOKS AFB (CONT)

- PRODUCT LINES - RESEARCH RELATED TO HUMAN SYSTEMS
  - CREW SYSTEMS INTEGRATION
  - HUMAN RESOURCES
  - AEROSPACE MEDICINE
  - OCCUPATIONAL/ENVIRONMENTAL HEALTH
  - EDUCATION/FORCE READINESS
  - MEDICAL/ENVIRONMENTAL SAMPLE ANALYSIS SERVICE
  - ENVIRONMENTAL COMPLIANCE SERVICES

FY95 HSC SNAPSHOT

- 3,249 People Managing $608 Million Annually
- 962 Scientists & Engineers
  - 400 Published Articles • 27 Patents, Inventions, Disclosures
  - 71 Focused Technology Areas
- 2,215 Degrees Held
  - 242 Doctoral • 570 Masters • 1,403 Bachelors
- 400 Acquisition Professionals
  - 40+ Development / Production Programs
  - 7,000+ Sustainment Items
- 128 Education / Training Instructors
  - 61 Aerospace Medicine Courses Graduating 4,768 Students
  - 8 System Acquisition Courses Graduating 1,385 Students

HSC ORGANIZATIONS



HUMAN SYSTEMS TECHNOLOGY

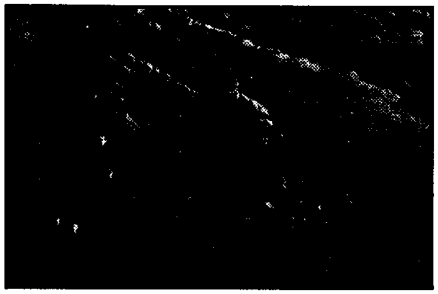
- DOD PERVASIVE, CORE TECHNOLOGY
  - REQUIRES IN-DEPTH FAMILIARITY WITH SERVICE OPERATIONS
  - REQUIRES TIGHT USER INTERFACE
- OFTEN MILITARILY UNIQUE, WITHOUT CIVILIAN COUNTERPART
- ENDORSED TO CSAF BY AFSAB 1994 SUMMER STUDY

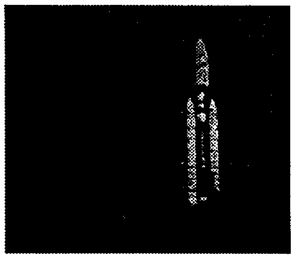
HUMAN SYSTEMS TECHNOLOGY WILL BE OF PARTICULAR VALUE FOR THE FUTURE

- FEWER NEW WEAPONS; AF MUST EXTEND DEMANDS ON CURRENT SYSTEMS AND CREW
- COMPLEX FUTURE WEAPONS SYSTEMS WILL REQUIRE IMPROVED DATA FUSION BY AIRCREW
- NIGHT AND ALL-WEATHER OPS WILL INCREASE DEMANDS ON CREWMEMBERS
- TRAINING AND SELECTION WILL BECOME EVEN MORE CRITICAL
- HUMAN SYSTEMS TECHNOLOGY = LEVER TO MAINTAIN FORCE EFFECTIVENESS DURING DOWNSIZING
- ENVIRONMENTAL LAWS IMPACT AIR BASE OPS, BASE CLOSURES, WASTE STREAMS

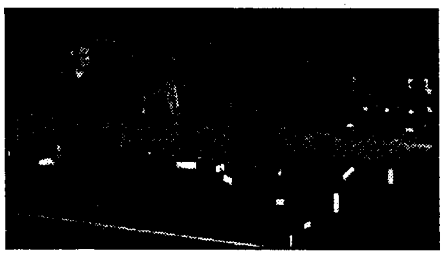
HSC IS LOGICAL ORGANIZATION TO BE FOCAL POINT FOR ALL HUMAN SYSTEMS TECHNOLOGY

- SINGLE MANAGER, ADVOCATE TO PREVENT FRAGMENTATION / ATTRITION
- AL IS ONLY LAB COORDINATING THROUGH MORE THAN TWO RELIANCE PANELS
- 1300 ACRES AT BROOKS AFB FOR FUTURE EXPANSION
- DOWNSIZING OPENS UP ADDITIONAL ROOM FOR FURTHER COLLOCATIONS
- NEW FACILITIES UNDER CONSTRUCTION AT BROOKS AFB
    - USAFSAM ACADEMIC COMPLEX
    - DIRECTED ENERGY LABORATORY
    - AFCEE BUILDING

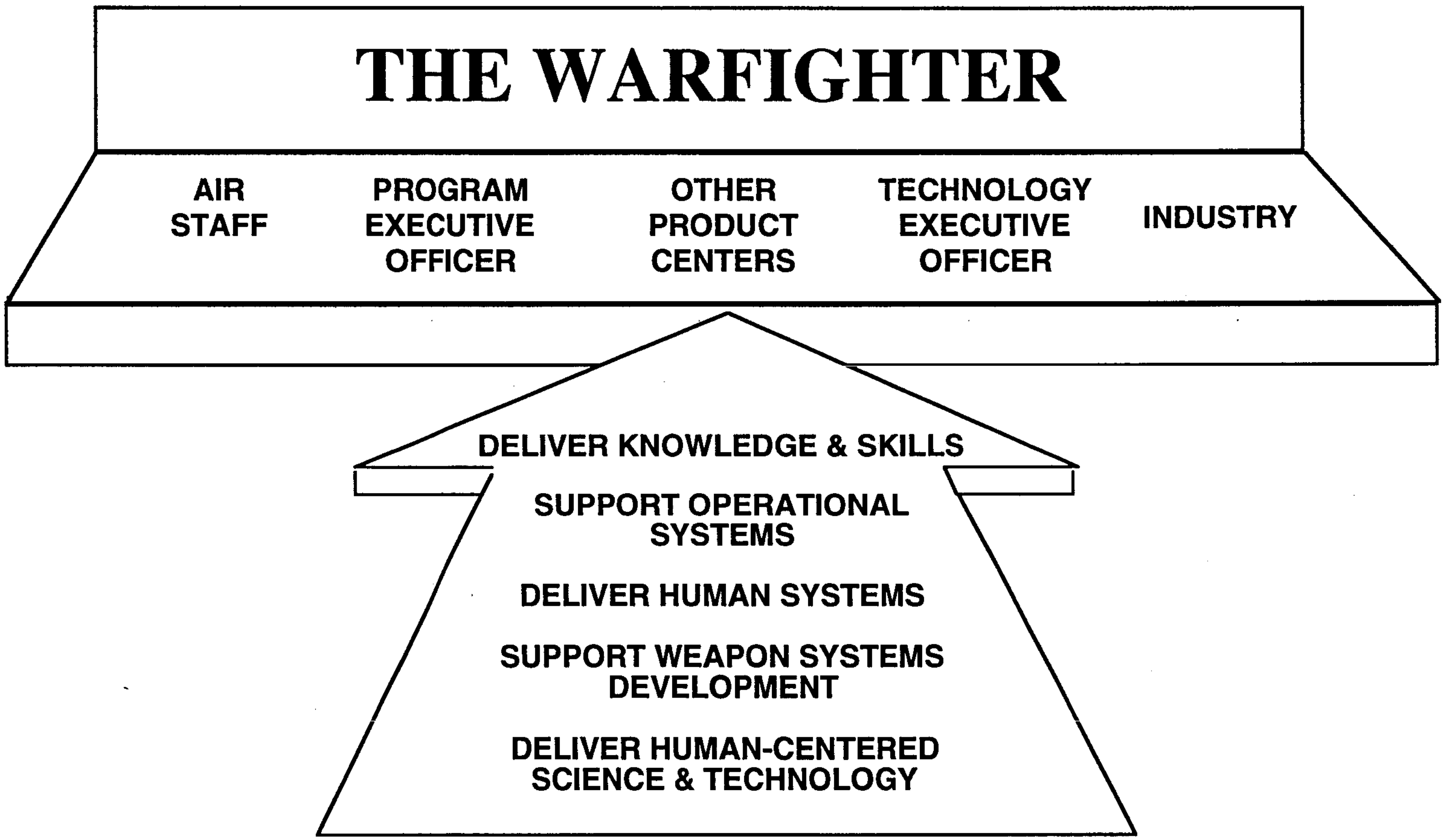




THERE ARE NO UNMANNED SYSTEMS



HSC'S MISSION



ARMSTRONG LABORATORY TECHNOLOGY TRANSITION TO HUMAN SYSTEMS PROGRAM OFFICE

- COMBINED ADVANCED TECHNOLOGY ENHANCED DESIGN G-ENSEMBLE (COMBAT EDGE)
- NIGHT VISION SYSTEM
- DISPOSABLE EYE / RESPIRATORY PROTECTION SYSTEM
- THERMAL FLASHBLINDNESS PROTECTION DEVICE
- AIRCRAFT MISHAP PREVENTION SYSTEM
- RAPID OPTICAL SCREENING TOOL (ROST)
- ACTIVE NOISE REDUCTION
- MAINTENANCE SKILLS TUTOR
- CIVIL RESERVE AIR FLEET AEROMEDICAL EVACUATION SHIPSETS
- ADVANCED TECHNOLOGY ANTI-G SUIT (ATAGS)
- MICRO COMPUTER INTELLIGENCE FOR TECHNICAL TRAINING (MITT)

INTEGRATION OF RESEARCH AND EDUCATION BETWEEN AL AND USAFSAM

- DEVELOPMENT OF THE ADVANCED SPATIAL DISORIENTATION DEMONSTRATOR
  - TRAINING PROTOCOLS FOR RECOGNITION OF SD AND RECOVERY TECHNIQUES
    - DEVELOPED FOR ACC AND AETC PILOTS
    - USAFSAM LEADS AND AL SUPPORTS
  - DEVELOPMENT OF REALISTIC FLIGHT SIMULATIONS
    - AL LEADS AND USAFSAM SUPPORTS
- COOPERATION IN RESEARCH AND EDUCATION MISSIONS - THE UNIVERSITY MODEL
  - USAFSAM EDUCATORS PARTICIPATE IN RESEARCH MISSION OF AL
  - AL SCIENTISTS AND ENGINEERS SERVE AS FACULTY MEMBERS IN USAFSAM

AL TIGHTLY INTEGRATED WITH SAN ANTONIO MILITARY COMMUNITY

- USAF SCHOOL OF AEROSPACE MEDICINE (SAM)
  - JOINT PROJECTS AND PERSONNEL EXCHANGES
- AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE (AFCEE)
  - RECIPIENT AND BROKER OF AL ENVIRONMENTAL TECHNOLOGIES
- HUMAN SYSTEMS PROGRAM OFFICE
  - TRANSITION HUMAN-CENTERED TECHNOLOGY
- AIR EDUCATION AND TRAINING COMMAND (AETC)
  - REQUIREMENTS, EVALUATIONS AND SUBJECTS FOR AIRCREW TRAINING R&D
- AIR FORCE MILITARY PERSONNEL CENTER
  - REPOSITORY FOR MPC DATABASE
- LACKLAND AFB
  - FACILITIES AND SUBJECTS FOR TRAINING AND SELECTION RESEARCH
- KELLY AFB
  - BIOREMEDIATION TEST SITE

GEOGRAPHICALLY-UNIQUE PROFESSIONAL SUPPORT

(WITH CIVILIAN COMMUNITY)

AUDIE MURPHY VETERANS HOSPITAL: CLINICAL HYPERBARIC MEDICINE SERVICES

UTSA: INTELLIGENT TUTORING SYSTEMS IN FUNDAMENTAL SKILLS
MILITARY WOMEN MEDICAL CARE COLLABORATIVE STUDIES

TRINITY UNIVERSITY: BIOEFFECTS OF ELECTROMAGNETIC FIELDS

SOUTHWEST RESEARCH INSTITUTE: VIBRATION TESTING

UTHSC, UTSA, TRINITY, SRI AND SYSTEMS RESEARCH LAB: LASER, MICROWAVE AND ELECTROMAGNETIC ENERGY STUDIES

TEXAS A&M: FOOD AND SAFETY RESEARCH

NASA: ENVIRONMENTAL TECHNOLOGY
RADIOLOGICAL AND TOXICOLOGICAL EFFECTS
ALTITUDE DECOMPRESSION SICKNESS

GEOGRAPHICALLY-UNIQUE PROFESSIONAL SUPPORT

(WITH MILITARY COMMUNITY)

KELLY AFB
- RADIOLOGICAL WASTE SITE CLEANUP AND SAFE MATERIAL DISPOSAL
- OCCUPATIONAL MEDICINE TRAINING

LACKLAND AFB
- TRICARE REGION VI REFERENCE LAB
- CLOSE PROXIMITY TO 30,000 RECRUITS FOR HUMAN-BASED RESEARCH

RANDOLPH AFB
- HIGH-G AWARENESS TRAINING FOR ALL AETC INSTRUCTOR PILOT TRAINEES
- CRITICAL FLYING REQUIREMENTS FOR 100 FLIGHT SURGEONS (ANNUALLY)

JOINT MEDICAL RESOURCE OPPORTUNITIES
- VETERINARY EXPERIENCE FOR RESEARCH IN MEDICAL SAFETY AND EFFICACY (BAMC)
- LOW COST TRAINING IN HEALTH PHYSICS (FORT SAM HOUSTON)

GEOGRAPHICALLY-UNIQUE CIVIC/SOCIAL SUPPORT

EDUCATION :

- SAN ANTONIO 2000 (HSC/CC CHAIRS PROGRESS REPORT COUNCIL)
- MENTORING PROGRAM (100-PLUS VOLUNTEERS)
- HIGHER EDUCATION INSTRUCTORS AT NEARBY UNIVERSITIES (100-PLUS)

MEDICAL :

- AFTER-HOURS MANPOWER SUPPORT TO LOCAL HOSPITALS
- PRACTICAL EXPERIENCE AVAILABILITY FOR LOCAL DOCTORAL STUDENTS

RUNWAY :

- AUTOMOTIVE RESEARCH AND TESTING
- SAFE-DRIVING TRAINING

MONEY / TIME :

- ALAMO FEDERAL EXECUTIVE BOARD
- HUNDREDS OF EMPLOYEES/THOUSANDS OF VOLUNTEER HOURS

USAF SCHOOL OF AEROSPACE MEDICINE

(USAFSAM)

PROVIDES TRAINING, EDUCATION, AND CONSULTATION IN THE AREAS OF HUMAN PERFORMANCE ENHANCEMENT, CONTINGENCY MEDICAL OPERATIONS, OCCUPATIONAL HEALTH, DISEASE PREVENTION, ENVIRONMENTAL QUALITY, AND AEROMEDICAL EVACUATION

USAFSAM

- INTERNATIONALLY RECOGNIZED
- 5000+ STUDENTS PER YEAR
  - AEROSPACE MEDICINE
  - AEROSPACE NURSING
  - AEROSPACE PHYSIOLOGY
  - PUBLIC HEALTH
  - BIOENVIRONMENTAL ENGINEERING
- ENTRY LEVEL THROUGH 4TH YEAR POST M.D.
  - USAF, DOD, AND ALLIED NATIONS

USAFSAM

- HIGHLY SYNERGISTIC RELATIONSHIP WITH AL AND YA
  - 30% OF USAFSAM PODIUM HOURS CONDUCTED BY AL AND YA SUBJECT MATTER EXPERTS
  - AL PROVIDES ESSENTIAL RESEARCH BASE FOR ADVANCED USAFSAM STUDENTS
  - USAFSAM STAFF PROVIDES OPERATIONAL INSIGHT FOR RESEARCHERS, PROGRAM MANAGERS

WE ARE THE HUMAN SYSTEMS CENTER

THE HUMAN IS THE HEART OF AEROSPACE SYSTEMS AND OPERATIONS

THERE ARE NO UNMANNED SYSTEMS

United States Air Force

FACT SHEET

Office of Public Affairs, Human Systems Center, 2510 Kennedy Circle, Suite 1, Brooks AFB TX 78235-5120 Phone (210) 536-3234 Fax (210) 536-3235

HUMAN SYSTEMS PROGRAM OFFICE

The Human Systems Program Office (HSC/YA) provides advanced performance, survival, and training technologies to U.S. and allied air and ground crews through development, production and sustainment of human-centered systems and services including life support; aircraft escape; computer-based training; chemical defense; aeromedical; Air Force uniforms; mishap analysis; and environmental technology. The program office demonstrates technology concepts in prototype systems to reduce technical, cost, and schedule risk, and to accelerate the transition of laboratory technologies to fielded systems. As the single acquisition arm of the Human Systems Center, the program office is responsible for proper execution of engineering and manufacturing development and production programs and coordinates acquisition efforts with other agencies and the using major commands. The Human Systems Program Office is also responsible for the Human Systems Center staff functional work in the areas of engineering, manufacturing/quality assurance, configuration/data management, test and evaluation, and acquisition logistics.

The program office was awarded the Air Force Materiel Command's General Bernard Schriever Award for Program Excellence in 1993, and the Department of Defense Superior Management Award in 1994.

HISTORY

Aeromedical casualty development and acquisition began in the early 1980s under the Aerospace Medical Division (AMD). In 1987, AMD was chartered the Human Systems Division (HSC) with expanded development and acquisition responsibilities in the areas of manpower/personnel/training and some life support programs. In April 1989, the life support, chemical warfare defense, and clothing divisions of Aeronautical Systems Division (ASD) were organizationally aligned under the HSD deputy commander for development and acquisition. The objective was to transition the HSD laboratories for these product areas to acquisition agencies under the leadership of one product division commander to better serve the using major commands. In the fall of 1989, the deputy commander for development and acquisition was designated a program director and the

(Current as of March 1995)

organization renamed the Human Systems Program Office. In July 1991, HSD/YA was identified one of the 21 selected programs to begin operation under the Integrated Weapon System Management (IWSM) concept and became the first IWSM office to reach full operational capability with the addition of a 60-person sustainment operating location at Kelly Air Force Base. On Jul. 1, 1992, the Human Systems Division became the Human Systems Center (HSC). The Program Office's primary mission is to conduct HSC's development, acquisition, evolution and sustainment programs in response to major commands' stated needs. The Program Office is organized into five product divisions with matrixed functional support divisions. The organization works with the other DOD components in fielding Department of Defense and Air Force systems.

The Life Support Systems Division develops equipment for aircraft air and ground escape, descent, survival and recovery; USAF uniforms/clothing; aircrew, passenger/ground support equipment and aircraft installed systems; along with the development of procedures and training requirements to assure proper utilization of such systems. The Chemical/Biological Defense Systems Division develops equipment for aircrew, passenger and ground support personnel protection, including both personal and collective protective equipment. The division also develops procedures and training requirements to assure proper utilization of the systems. The Aeromedical Systems Division develops Air Force-unique medical field equipment and systems, as well as all tactical and strategic aeromedical evacuation systems for the Department of Defense and develops decision-support models to assist war planners' understanding of the causes and circumstances resulting from the loss of combat forces to facilitate war and mobilization planning of combat personnel and logistical requirements.

The Human Resource System Division develops and produces computer-based training and intelligent tutoring systems to enhance the capabilities within the manpower, personnel, training, and safety arenas to improve personnel capabilities and force readiness. The Medical Systems Training Division directly supports the automation goals of the Air Force Surgeon General by conducting all aspects of implementation, to include, but not limited to, site surveys, statements of work, system manager training, applications training, and direct onsite implementation support of the Composite Health Care System, Ambulatory Data Collection System, Provider Work Station, and the Defense Medical Human Resources System.

The Environmental Systems Division is responsible for demonstrating environmental systems and technology concepts in prototype systems to reduce technical, cost, and schedule risk and to accelerate transition of laboratory technologies to fielded systems. Within these activities are site remediation systems, compliance systems, and pollution prevention, along with development of procedures and training requirements to assure proper utilization of the systems. The Life Support System Support Management at the System Support Division has the worldwide management and technical responsibility for fielded USAF/FMS aircrew personal equipment and aircraft escape systems which includes ejection seats, personal equipment items, articles, systems and subsystems used in air, ground and space operations for human-centered protection. The The Life Support mission is accomplished through Inventory Management Specialists and Logistic Management Specialists.

HUMAN SYSTEMS PROGRAM OFFICE
(A/O Apr 95)

1990 AFSC Commander's Trophy for Program Excellence, Systems Program Office of the Year
1993 AFMC General Bernard A. Schriever System Program Office of the Year Award
1994 DoD Superior Management Award

MISSION

Provide advanced performance, survival, and training technologies to US and allied air and groundcrews through development, production, and sustainment of human centered systems and services including life support; aircraft escape; computer based training; chemical defense; aeromedical; AF uniforms; mishap analysis; and environmental technology.

PROGRAM DIRECTOR

Mahlon H. Long III, Colonel

TALKING PAPER

ON

HUMAN SYSTEMS PROGRAM OFFICE (SPO)

PURPOSE
- Provide a snapshot of SPO mission, structure, personnel, through-put

MISSION
- Provide advanced performance, survival, and training technologies to US and allied forces through cradle-to-grave development, production, and sustainment of human centered systems and services

PRODUCT AREAS (Selected examples described in attached fact sheets)
- SPO consists of AF-unique product-focused divisions and functional support
  -- Aircrew Life Support Systems
    --- Ejection seats, survival gear, anti-G equipment, helmets, night vision, etc.
  -- Nuclear, Biological, and Chemical Warfare Defense Systems
    --- Individual and collective protection, detectors, decontamination
  -- Aeromedical Systems
    --- Casualty care, chemically hardened medical systems, medical simulation and modeling, aeromedical, etc.
  -- Training Systems
    --- Intelligent tutoring, training development, and management aids, etc.
  -- Environmental Systems
    --- Site characterization, clean up, prevention
  -- Medical Systems Implementation and Training
    --- Deploying automated integrated hospital patient administration system
  -- Air Force Uniforms
    --- Design, test, and specify all AF uniforms

PERSONNEL (Authorized)

- Military personnel:	BAFB: 167	WPAFB: 1	KAFB: 4	
- Civilian personnel:	BAFB: 153	WPAFB: 12	KAFB: 34	Philadelphia: 7
- TEAMS/FFRDC:	BAFB: 82/8			

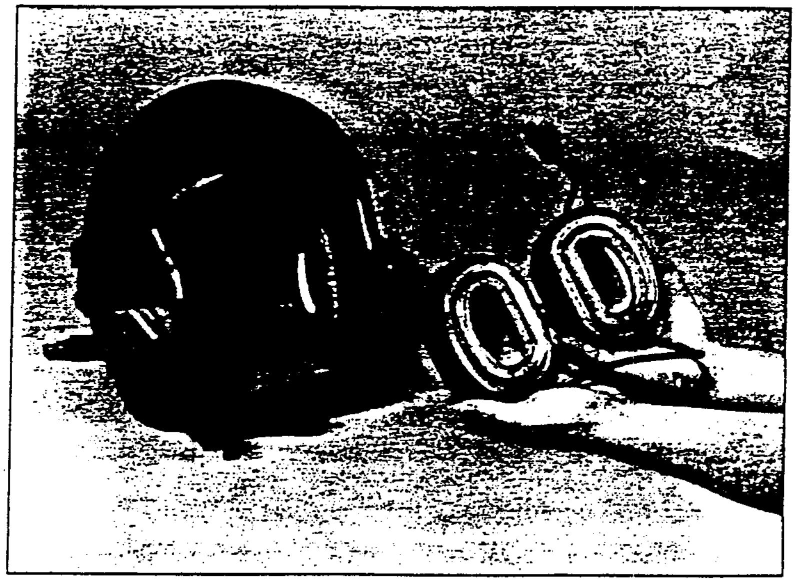
1994 $ MANAGED THROUGH-PUT: $38M development; approx $100M production

CUSTOMERS
- All Air Force major commands and Air Staff
- Other Air Force Materiel Command Product and Logistics Centers
- Other DoD services
- Other US government agencies
- Foreign countries

LIFE SUPPORT SYSTEMS
HSC/YAS

ANR
(Active Noise Reduction)

Program Objective: To investigate a new electronic approach to noise attenuation in aircrew helmets to reduce hearing loss, reduce fatigue to the crew member caused by the noise and improve communications capability.
(See Page 37 in HSC's "Products and Progress" report)



The Active Noise Reduction earcups, as installed in an aircrew helmet (HGU-55/P), will electronically reduce annoying or distracting background noise.

COMBAT EDGE

(Combined Advanced Technology Enhanced Design G-Ensemble)

Program Objective: Provide fighter pilots with enhance protection against the effects of Gs and improve pilot endurance using a Pressure Breathing for G system that reduces dependence on the anti-G straining maneuver. (See Page 20 in HSC's "Products and Progress" report)

Equipped with COMBAT EDGE, pilots can tolerat greater levels of "G" force.

UWARS

(Universal Water-Activated Release System)

Program Objective: To provide the crew member with an automatic backup parachute release capability that will release the parachute canopy upon entry into saltwater.
(See Page 26 in HSC's "Products and Progress" report)

Compared to the AFSEAWARS, the new UWARS is significantly more streamlined and comfortable to wear.

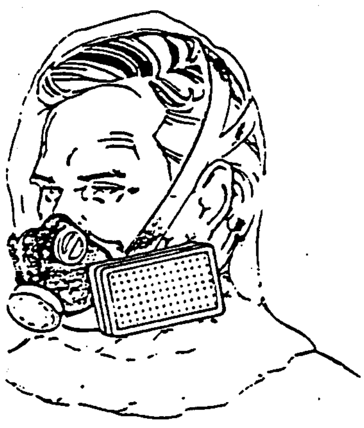
AERP
(Aircrew Eye-Respiratory Protection)

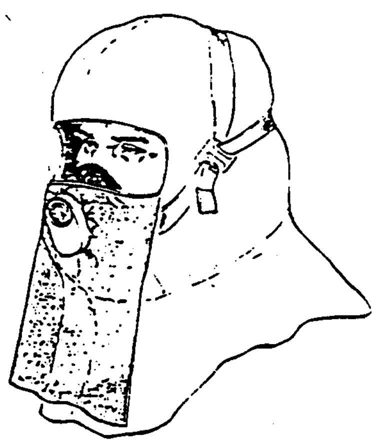
Program Objective: To replace the MBU-13/P chemical/biological oxygen mask. Final objective is equip all crew members in all aircraft with a chemical defense capability. System enhanced capabilities include better chemical/biological protection, under-the-helmet design, drinking capability, and ability to perform a valsalva maneuver.
(See Page 14 in HSC's "Products and Progress" report)

An F-16 pilot prepares for a mission while wearing Aircrew Eye/Respiratory Protection.

DERP
(Disposable Eye/Respiratory Protection)

Program Objective: To develop an inexpensive, compact, disposable mask to provide emergency protection in a chemical warfare environment. Provide head, eye, neck, and respiratory protection in an environment contaminated with chemical nerve and blister agent vapors, aerosols, and liquids.
(See Page 13 in HSC's "Products and Progress" report)





Three prototypes are currently being considered.

GCE
(Ground Crew Ensemble)

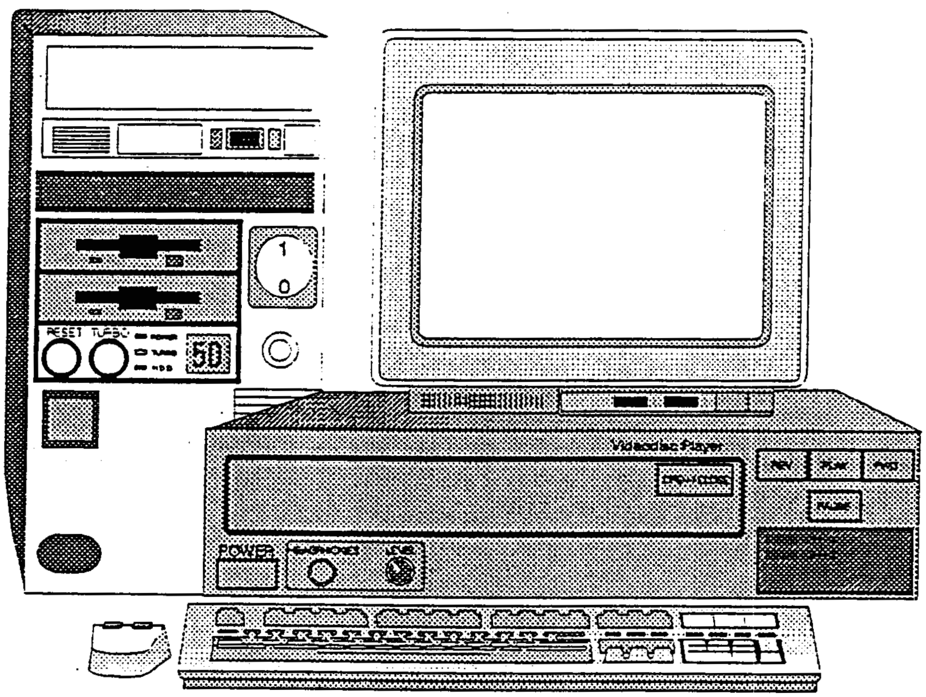
Program Objective: To design and develop a one- or two-piece clothing configuration with hood to provide liquid vapor, and aerosol chemical protection. It provides a reduction in the thermal burden as compared to the current ensemble and is washable. (See Page 9 in HSC's "Products and Progress" report)

Even when life threatening chemicals are present, the ground crew will be able to perform their mission with minimal discomfort.

HUMAN RESOURCES SYSTEMS
HSC/YAR

MST
(Maintenance Skills Tutors)

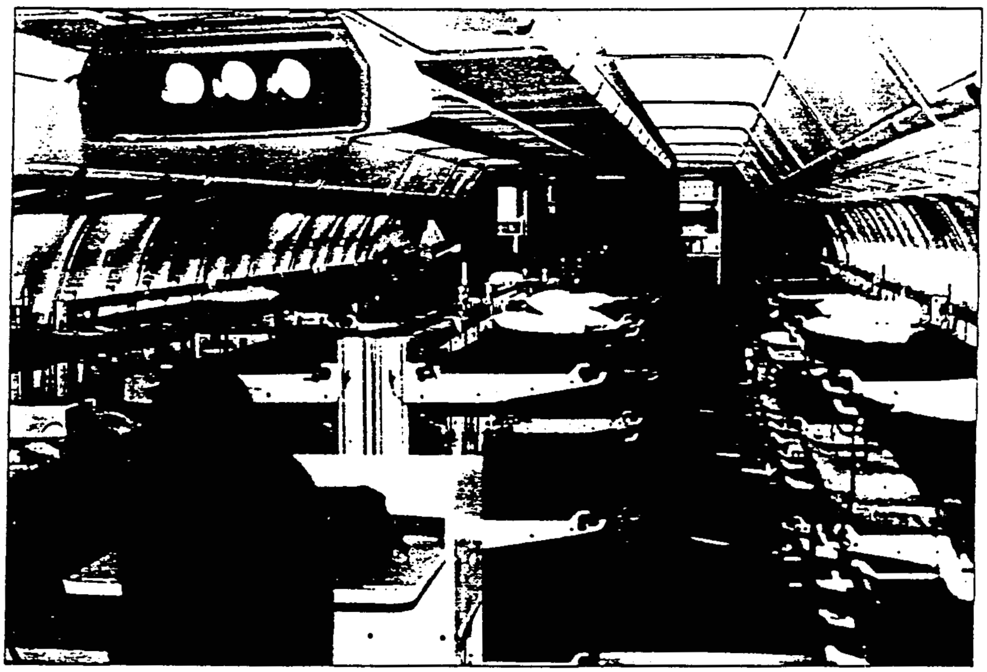
Program Objective: To develop computer-based training systems that use artificial intelligence to teach advanced trouble-shooting skills to improve tactical air forces maintenance.
(See Page 76 in HSC's "Products and Progress" report)



CRAF-AES

(Civil Reserve Air Fleet Aeromedical Evacuation Shipsets)

Program Objective: To convert commercial Boeing B-767 aircraft to aeromedical evacuation platforms by removing airline interiors and installing litter stanchions. liquid oxygen converters, and electrical power converters.
(See Page 86 in HSC's "Products and Progress" report)



Installation of these shipsets in existing commercial B-767s will enhance our wartime capability to evacuate the injured.

United States Air Force

FACT SHEET

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USAF SCHOOL OF AEROSPACE MEDICINE (AFMC)

The U.S. Air Force School of Aerospace Medicine at Brooks Air Force Base is noted internationally as a premier center of aerospace medical learning.

The cornerstone of the school and the historical reason for the importance of the word "school" in the name is the aerospace medicine education program. Approximately 5,000 people per year are trained at the school.

This training is conducted for all of the entry level aeromedical specialties, officer and enlisted. Specialized training is provided, usually at the graduate level, for flight surgeons, flight nurses, bioenvironmental engineers, aerospace physiologists and public health officers.

The USAF School of Aerospace Medicine had its inception in 1918 as the Medical Research Laboratory of the Air Service, U.S. Army Signal Corps, Hazelhurst Field, New York. In 1922, it was redesignated the School of Aviation Medicine and four years later, was moved to Brooks Field, Texas.

In 1931, the school was relocated at Randolph Field, Texas, where on Feb. 9, 1949, the Department of Space Medicine was established by Brigadier General Harry G. Armstrong, school commandant. Dr. Hubertus Strughold was appointed the first permanent chief of the department in May 1949.

Expansion of the school's mission was responsible for its move back to Brooks Air Force Base in 1959 and redesignation as the USAF School of Aerospace Medicine, which is now a part of Air Force Materiel Command Human Systems Center.

As part of its special relationship with the Air Force School of Aerospace Medicine, the Armstrong Laboratory provides instructional expertise and access to its vast aeromedical databases, information resources and laboratory facilities.

(Current as of March 1995)

United States Air Force

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AIR FORCE MEDICAL SUPPORT AGENCY

The Air Force Medical Support Agency (AFMSA) is a field operating agency with headquarters at Brooks Air Force Base, Texas. The AFMSA, formerly the Air Force Office of Medical Support, was organized and became operational on July 1, 1992. The AFMSA commander reports to the director, Medical Programs and Resources, Office of the Surgeon General.

The Air Force Medical Support Agency mission is to improve global performance and capability of the Medical Service in supporting combat forces and maintaining the health of beneficiaries. It is the Air Force Surgeon General's primary focal point for policy development, strategies, plans, consultant services, and validated requirements dealing with facilities, supplies, equipment, acquisition, information systems and resources, and patient administration. This is accomplished through its four divisions: patient administration, medical facilities, medical information systems, and medical logistics. The Air Force Medical Logistics Office located at Fort Detrick, Md., is also assigned to AFMSA.

The patient administration division manages policies and procedures for patient administration, clinical records and outpatient records activities within all medical treatment facilities.

The medical facilities division serves as focal point for Air Staff management and coordination of all matters pertaining to medical and dental treatment facilities through the Military Construction Program, facilities maintenance and improvements and medical facility design. It provides consultation and advisory services to the major command surgeons and medical treatment facilities' commanders on all medical/dental facility-related issues. Three regional health facilities offices support construction activities throughout the Medical Service. These include the western region office in San Francisco, the central region office in Dallas and the eastern region office in Atlanta.

(Current as of March 1995)

The medical information systems division is the focal point for plans, policies, programs, and consultation dealing with information engineering, technology, and management within the Surgeon General's staff and the Air Force Medical Service. The division is responsible for worldwide deployment program management of all automated information systems in the Air Force Medical Service. It also serves as the central data repository for biostatistical data in support of the USAF Medical Service worldwide.

The medical logistics division develops plans and policies concerning medical materiel (both supply and equipment), biomedical equipment maintenance and repair, service contracts, medical materiel support and medical facilities management. The Air Force Medical Logistics Office is an operational element of the medical logistics division. It functions as an operational control center for medical materiel in direct support of all base medical facilities, major commands, Air Force Reserve, Air National Guard and various defense supply centers. It is the direct contact point with Defense Personnel Support Center and all Air Force materiel activities. It is the Air Force's single manager of war reserve materiel, medical commodities and provides technical operational guidance and surveillance of base and major command medical materiel maintenance activities.

AFMSA is directly involved with the Air Force Surgeon General, other Air Staff directorates, major commands, Air Force medical treatment facilities, and other federal agencies on a daily basis. A continuing interchange is required as operational policy and practices for medical support are developed and implemented.

United States Air Force

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70th TRAINING SQUADRON
THE SYSTEMS ACQUISITION SCHOOL

The Systems Acquisition School (SAS) was founded in 1982 by General Marsh, commander of Air Force Systems Command. Its mission was to provide program management training for new acquisition managers from throughout the command. Since that initial beginning, the school has expanded and continues to provide for the unique training requirements of Air Force Materiel Command in support of Congressionally mandated professional acquisition certification.

The instructor staff is made up of acquisition professionals from throughout the command. They have real-world experiences to share which is one of the secrets of success at the SAS. Two key "long-standing" courses are the Computer Resources Acquisition Course (CRAC), a two-week course for individuals charged with acquiring hardware and software; and the Intermediate Systems Acquisition Management (ISAM), an equivalent course to AFIT's Systems 200, but in a two-week format.

Other courses include Subcontract Program Management (SPM), a one-week course in the specifics of dealing with subcontractor issues on a program; Work Measurement, a one-week course specializing in applying work measurement data to specific pricing applications for use in negotiations. The Laboratory Acquisition Management Course (LAMC) was introduced last year to provide two weeks of introductory training to people new to the laboratory environment. New to the school this coming year will be a new two-week Integrated Product Support Course with a heavy emphasis on the logistics and support aspects of new and ongoing programs. We will also offer a Basic Systems Acquisition Management Course geared to medical specialists.

(Current as of Oct. 1994)

The registrar and course development staffs provide critical support to the instructors in the classroom. Whether a course is being taught at the school, with 30 students in attendance, or on the road with 150 students, the registrar ensures each and every student meets the course requirements and receives proper credit for their efforts. The Course Development staff provides the assistance the instructors require in maintaining our courses as the most up-to-date courses available. The school is organized along the Integrated Product Development philosophy, with teams for each course offered. This allows SAS to present the courses they do with a staff totaling 32 people. People interested in attending a SAS course should check with their training monitor.

United States Air Force

FACT SHEET

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70th Air Base Group

Mission

The 70th Air Base Group operates and maintains Brooks Air Force Base, Texas, in support of the Human Systems Center and associate units, providing base-level support to all organizations located on Brooks Air Force Base. It supports the mission of HSC by providing base operations support and administrative services to the HSC organization and its tenants. HSC is a part of the Air Force Materiel Command.

History

The 70th Air Base Group's origin can be traced back to April 8, 1958, when it was first known as the 2577th Air Base Group, belonging to the 10th Air Force. On Oct. 1, 1959, the 2577th ABG was redesignated the 3790th Air Base Group, becoming an important part of the Aerospace Medical Center. It received the 6570th Air Base Group designation on Nov. 1, 1961, when the Aerospace Medical Division (now Human Systems Center) was organized. On Oct. 1, 1992, the 6570th Air Base Group became the 648th Support Group in response to the objective center concept, and on 1 Sept. 1993, the 648th Support Group became the 648th Air Base Group. On 1 Oct. 1994, the 648th Air Base Group became the 70th Air Base Group.

Organization and Responsibility

The responsibilities of the 70th Air Base Group include administration, civil engineering, logistics, base plans, disaster preparedness and morale, welfare, recreation and services. Additionally, the Group is responsible for the social actions office, the headquarters squadron section, and the Edward H. White II Memorial Museum.

Squadrons within the scope of the 70th Support Group also play a vital part in the organization's support mission.

The 70th Civil Engineering Squadron is responsible for the upkeep and repair of base facilities. Duties include the planning, engineering and drafting of all future construction projects on the base, base fire protection, housing maintenance and environmental engineering.

(Current as of Oct. 1994)

The 70th Security Police Squadron provides law enforcement, resource protection and information and industrial security program. The squadron offers many services to the public in areas of crime prevention.

The 70th Services Squadron includes billeting, food service flight and the furnishing management flight. The Services Squadron also acts as the support group commander's liaison with the base exchange and commissary on matters concerning customer support, support to the base population and hours of operation. Additionally, the base mortuary affairs officer is a part of this squadron. This section is responsible for handling all active duty, dependent and retiree deaths on base. The squadron is also responsible for all classic services functions at Brooks AFB. This includes the child development center, youth activities center and Family (Recreational) Camp.

The 70th Logistics Squadron consists of three branches: medical logistics, base supply and transportation. Medical logistics and base supply branches provide medical and non-medical supplies and equipment to Brooks AFB units. Base transportation includes management and operations of the base vehicle fleet, the traffic management office, SATO and the freight movement section.

Associate Units

The 70th Air Base Group provides support to associate units on Brooks Air Force Base. These include the 70th Medical Squadron, the 70th Communications Squadron; 70th Training Squadron; Det. 108, Air Force Office of Special Investigations; 6906th Electronic Security Squadron, and two field operating units, the Air Force Center for Environmental Excellence (AFCEE), and the Air Force Medical Support Agency.

United States Air Force

FACT SHEET

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ARMSTRONG LABORATORY
MISSION

The Armstrong Laboratory plans, manages and conducts research, advance development and specialized operational support, all focused on the readiness, maintenance, protection and enhancement of human capabilities.

The laboratory is an integral element of the Human Systems Center (HSC), the prime systems-independent advocate for human-centered concerns in Air Force weapon systems design, development and deployment. Laboratory research and development efforts complement, are coordinated with, and link HSC programs in development planning and human systems acquisition.

Laboratory products assure human system performance at individual, crew, team and force levels, enabling the Air Force to meet current and future operational requirements in the functional areas of aerospace medicine, crew systems, human resources, and occupational and environmental health. Highlighting man as the ultimate enabling factor in Air Force weapon systems, the Armstrong Laboratory sponsors and conducts research and development in the fields of biodynamics, biocommunication, toxic hazards, radiation/directed energy bioeffects, aeromedical selection/retention, human engineering, crew protection/life support, logistics and human factors, force acquisition and management, instructional strategies, job skill development and retention, and training devices/systems.

Responding to customer needs and maintaining our superiority in the human systems technology area, the laboratory builds the technological framework upon which systems acquisition excellence is based.

The laboratory consists of a command section, operations and support, financial management, contracting staff, plans and programs functional directorate and four functional technical directorates.

(Current as of April 1994)

The functional directorates are interdisciplinary entities structured to address Air Force future capability needs in aerospace medicine, occupational and environmental health, crew systems and human resources.

The plans and programs directorate is responsible for program and process analysis, planning and decision support for the Armstrong Laboratory's scientific, technical and operational support programs.

This directorate reviews mission and planning documents as well as systems under development to identify relevant human systems technology needs and objectives which meet users needs. The plans and programs directorate coordinates customer activities and develops advocacy products for the Armstrong Laboratory.

* * * *

The Aerospace Medicine Directorate conducts research, development, and operational support applying medical principles to the selection, retention and maintenance of people in Air Force operations. It is responsible for monitoring various disease study-groups in the flying population and maintaining associated databases.

Findings from these studies support the early detection of disease in this critical Air Force personnel resource, enabling more successful treatment and return to the cockpit where flight safety is not compromised. Within this directorate are special laboratory programs in epidemiologic research and field support, dental service equipment evaluation, hyperbaric medicine, and certified substance abuse testing.

* * * *

The Occupational and Environmental Health Directorate assesses risks to personnel from hazardous materials, noise, electromagnetic radiation, and occupational processes in Air Force operations, and conducts research and development to reduce such risks.

The directorate works with all echelons of USAF Commanders to acquire, operate, maintain, and dispose of weapon systems within the guidelines of environmental law and regulation. Through broad field consultation responsibilities, it captures and maintains an extensive data base of observed occupational illness and environmental hazards.

It studies interactions between environmental hazards, USAF operations and personnel, and applies the resulting knowledge to mitigate impacts on health and to maintain technological superiority concerning the biological effects of radiation/directed energy.

* * * *

The Crew Systems Directorate conducts research, development, and field support to integrate human operators with weapon systems and to optimize human combat performance, protection and survivability.

It researches human physical, physiological and behavioral characteristics and stress tolerances to develop permissible crew exposure limits, crew station and equipment design criteria and protective countermeasures.

The directorate develops design tools and prototype crew stations and equipment to provide a competitive advantage to military combat crews. It manages laboratory programs in anthropometry, sustained acceleration, workload analysis, helmet mounted systems, bioacoustics and biocommunications, biodynamic modeling, escape systems, life support, chemical defense, aeromedical evacuation equipment evaluation, high altitude exposure, sustained operations, spatial orientation and crew vulnerability reduction. It provides field support to solve related problems encountered in operational systems.

* * * *

The Human Resources Directorate performs scientific research and develops technologies and methods to acquire, classify, train, integrate, manage and retain Air Force human resources for maximal combat effectiveness

Human resources studies seek to match people with the most appropriate jobs, to enhance productivity through understanding the elements of job performance, to model and predict force-wide career flow options, and to analyze manpower, personnel and training components to reduce weapon systems life cycle costs.

It develops training devices/systems and instructional strategies with particular emphasis on aircrew skills. It develops methods, processes and tools to facilitate early incorporation of supportability considerations in the acquisition process, thereby improving weapon system sustainability and reducing operational resource requirements.

Also, it develops methods to improve intelligence and space support systems, and combat logistics technologies to aid maintenance performance.

* * * *

The Environics Directorate supports the Air Force mission by reducing the cost of cleaning up past waste sites while assuring, through compliance, the completion of critical wartime and peacetime missions. Environmental quality efforts at Tyndall Air Force Base, Fla., center on low-cost, highly effective ways to prevent environmental problems and to restore existing facilities.

The directorate has a state-of-the-art analytical laboratory, staffed by engineers, chemists, microbiologists, other scientists, and technicians. The extended research base that supports this laboratory includes investigators from colleges and universities throughout the United States as well as cooperating research partners in private institutions, industry and other federal laboratories.

* * * *

As part of its special relationship with the Air Force School of Aerospace Medicine, the Armstrong Laboratory provides instructional expertise and access to its vast aeromedical databases, information resources and laboratory facilities.

United States Air Force

FACT SHEET

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HYPERBARIC MEDICINE

The role of the Davis Hyperbaric Center has expanded tremendously since 1974 when its primary purpose was to treat aviators suffering from decompression sickness. The center is now internationally recognized as a leading authority in patient treatment, facility requirements, safety standards and research using hyperbaric oxygen (HBO). HBO is used to treat medical disorders such as chronic nonhealing wounds, carbon monoxide poisoning, osteoradionecrosis, gas gangrene, and air gas embolism. The Davis Hyperbaric Center presently serves as the lead agency for all DOD Clinical Hyperbaric Facilities, and as the center establishing policy for all USAF Clinical and Operational (Field) Hyperbaric Facilities.

During the past year, our personnel treated over 3316 patients. Staff physicians provide worldwide consultation activities around the clock. As the DOD lead agency, the center coordinates facility expansion and personnel training, including clinical hyperbaric medicine fellowships and advanced training courses for DOD medical personnel.

HBO personnel work to broaden the understanding, application, and acceptance of HBO therapy for new and different disease processes through both clinical and basic scientific research. Our team members spearhead medical research efforts in the areas of oxygen toxicity, recompression therapy, bums, crush injury, and NBC combat casualty care. They have established contacts with private and governmental research organizations in facilities research. The Davis Hyperbaric Center leads the way in hyperbaric chamber design and fabrication. Efforts are underway for improved design and construction of facilities, and to correct design deficiencies in the oxygen delivery system in the C-21 aircraft for transporting HBO patients.

(Current as of April 1994)

The primary payoff is reduced overall healing time for many debilitating wounds. This translates directly into reduced hospitalization times and associated medical costs for the DOD. For example, studies show that HBO reduces the health care costs for treating burn patients by as much as 30 percent. Evaluation of alternate construction strategies may result in greatly reduced construction cost. In addition, longterm payoffs will result from ongoing research particularly in the realm of diabetes.

United States Air Force

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CENTRIFUGE

When Brooks Air Force Base began pilot training in World War I, the gravitational effects (G forces) on the human body caused by aircraft dive pullouts and sharp turns were not a major concern to aviation researchers even though pilots were reporting degradation of vision and "fainting in the air" (loss of consciousness) when performing highspeed maneuvers. As the Air Force's aircraft inventory grew more sophisticated and faster, reports of acceleration (G) problems increased in number becoming a more important operational problem for fighter planes. It was apparent that these G effects could cause accidents with possible loss of aircraft and aircrew. A test vehicle was needed to study these problems in a controlled and safe environment. In 1938, the first such vehicle (a centrifuge for human use) was built at Wright Field (now Wright-Patterson Air Force Base, Dayton, Ohio.

In 1964, the U.S. Air Force School of Aerospace Medicine, now a unit of the Human Systems Center, installed a large centrifuge at Brooks Air Force Base to study such higher G effects on humans and to develop life support equipment to help protect aircrews from these effects. Research support equipment was installed to include pulmonary, blood gas and cardiovascular monitoring facilities, and data and video equipment to help record human physiologic response to high-sustained G forces. The centrifuge is now operated by the Armstrong Laboratory crew systems division.

The primary missions of this centrifuge were to provide:

-- a test vehicle for developing and assessing the effectiveness of experimental aircrew G-protection equipment and methods.

-- a means for indoctrination and training of aeromedical specialists and other aircrew personnel in the use of these protective techniques.

(Current as of April 1994)

The centrifuge could accomplish acceleration onset rates up to 1.5 G per second which was adequate to simulate the performance of the aircraft of that time. In 1971, a USAFSAM centrifuge human G tolerance record of 9 Gs for 45 seconds was established using the G proitective equipment and straining techniques developed at USAFSAM. At that time, high performance aircraft such as the F-15 and F-16 were in design and the achievement of this new high G record helped to prove that pilots could effectively fly these new aircraft. As studies in acceleration physiology continued, it was learned that the rate of G onset, as well as G level, was a very important factor in the effect of G on humans. It was obvious that the original centrifuge could not simulate the G onset rates of the newer high performance aircraft. In September 1984, the Brooks Air Force Base centrifuge was modified to boost the G onset rate from 1.5 G per second to 6 G per second and to update the control system and physiological monitoring equipment.

Scientists at the Human Systems Center have developed new protective equipment such as pressure breathing systems, an advanced anti-G suit and valve, physical conditioning programs to increase G tolerance and advanced straining techniques that pilots of the new high performance aircraft needed to survive and perform in the new high G environment. This centrifuge has also been used to train thousands of aeromedical specialists in the proper use of this equipment and techniques.

The HSC centrifuge has proven to be a valuable tool to the Air Force and is continuously used by researchers to investigate present and future areas of acceleration effects and protection not even conceivable to the early aviation cadets who flew out of Brooks Field during World War I.

United States Air Force

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COMBAT EDGE

COMBAT EDGE, a protection system for F-15 and F-16 crewmembers, provides a pressurized source of air to pilots. It uses positive breathing for G to combat gravity-induced loss of consciousness. G-LOC can occur when highspeed aircraft perform maneuvers that create G forces which draw blood away from the brain.

The acceleration of modern fighter aircraft can exceed the physiological protection afforded by traditional life support equipment. This results in either not making full use of an aircraft's performance capabilities or risking unconsciousness and severe fatigue. COMBAT EDGE automatically provides positive pressure breathing assistance and helps reduce the onset of G-LOC.

This introduction of positive breathing for G to the cockpit is with minimum change to existing aircraft systems and personal equipment. Crewmembers will continue to use their usual flight and G-suits, parachute harnesses and helmets. The helmet is modified to incorporate an automatic mask tensioning system required for the new pressure breathing mask. Because breathing pressures will reach fairly high levels, a vest will also be worn to provide balanced respiratory counterpressure to the chest surface and prevent breathing difficulty.

Associated hardware and hoses connect the crewmember's personal gear to aircraft equipment. The aircraft-side equipment includes a new low-resistance breathing regulator, a modified high flow G-valve that senses Gs, and a sense line that ties them together.

This basic configuration has been tested and its performance validated in centrifuge studies and development, test and evaluation flights. When DT&E is completed, the program will move on to the operational testing. Production will then be increased to equip both the F-15 and F-16 fleets by the end of 1992.

This technology and resulting productswill offer relief from the hazard of G-induced loss of consciousness while promising to confer tactical (high G) and theater (sortie surge) capabilities as well.

(Current as of June 1991)

United States Air Force

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HUMAN SYSTEMS CENTER

MISSION

The Human Systems Center of Air Force Materiel Command, headquartered at Brooks Air Force Base, Texas, is the Air Force advocate for integrating and maintaining the human in Air Force systems and operations. People are the key to all Air Force operations. HSC is the systems-independent product center for human-centered research, development, acquisition and specialized operational support.

Its mission is to protect and enhance human capabilities and human-systems performance with a scope of impact ranging from the individual to combatant command forces including DOD and Allied Nations Forces. The Armstrong Laboratory, the USAF School of Aerospace Medicine, the HSC Program Office (YA), the 70th Medical Squadron and an air base group are the major units of HSC.

HISTORY

HSC's origins go back to Jan. 19, 1918, when the Medical Research Laboratory was formed at Hazelhurst Field, N.Y. In 1922, this Laboratory was redesignated the School of Aviation Medicine, and four years later it moved to Brooks Field which was a center for primary flight training. Both organizations moved to Randolph Field in October 1931. The school moved back to Brooks during the summer of 1959 and the base became the headquarters for the Aerospace Medical Center the same year.

The Center represented the initial step in placing the management of aerospace medical research, education and clinical medicine under one command. Both the school and center were reassigned from Air Training Command to Air Force Systems Command in November 1961 and assigned to the new organization, Aerospace Medical Division (now HSC).

(Current as of Oct. 1994)

On Nov. 21, 1963, President John F. Kennedy dedicated four new buildings of USAFSAM in the complex that housed the Aerospace Medical Division. This was his last official act before his assassination in Dallas the following day.

In 1986, the Department of Defense began streamlining its organization as a result of the Packard Commission recommendations. This division's acquisition mission emphasized its human-centered technologies. It restructured its functional areas and was renamed the Human Systems Division on Feb. 6, 1987.

In December 1990, the Air Force Systems Command underwent a major restructuring which consolidated 16 laboratories nationwide into four. Brooks Air Force Base and the Human Systems Division became home of one of the "super labs." The new lab, named the Armstrong Laboratory, is a world-class center in science and technology for protecting the human in Air Force systems.

On July 1, 1992, the Human Systems Division was renamed the Human Systems Center as part of the structuring of the new Air Force Materiel Command. The command was activated July 1, 1992, when the Air Force Logistics Command and Air Force Systems Command were integrated.

ORGANIZATIONS

The Human Systems Center headquarters supports its subordinate organizations with administration, command and control, and logistics.

U.S. Air Force School of Aerospace Medicine

As the center for aerospace medicine education, the USAF School of Aerospace Medicine is the major provider of educational programs involving aviation, space, and environmental medicine for Air Force, DOD, and Allied Nations personnel. The programs span entry level through graduate medical education in all disciplines encompassed in the aerospace medicine specialty.

70th School Squadron

The 70th Training Squadron advances the education of acquisition professionals to support and sustain all Air Force weapons systems. About 1,500 students are trained annually.

Human Systems Center Program Office

The program office is responsible for the engineering and manufacturing development, production, evolution and sustainment of life support, chemical defense, aeromedical, human resource, and operational analysis systems, and the design and test of Air Force uniforms. The program office demonstrates technology concepts in prototype systems to reduce technical, cost, and schedule risk, and to accelerate the transition arm of the Human Systems Center.

It is responsible for proper execution of engineering and manufacturing development and production programs and coordinates acquisition efforts with other agencies and the using MAJCOMs. The program office is also responsible for the Human Systems Center staff functional work in the areas of engineering, manufacturing/quality assurance, configuration/data management, test and evaluation, and acquisition logistics.

70th Air Base Group

The 70th Air Base Group operates and maintains Brooks Air Force Base in support of HSC and tenant units.

The Armstrong Laboratory

The Armstrong Laboratory, as one of the four Air Force "Super Laboratories," is the Air Force's center of excellence for human-centered science and technology. The laboratory provides the science and technology base and the direct operational support needed to enhance human performance in Air Force systems and operations. The research, development, and support activities of the laboratory address current and future needs in the areas of human resources, crew systems, aerospace medicine, and occupational and environmental health to enhance crew protection and performance, training and logistics, and force management, health and safety.

70th Medical Squadron

The 70th Medical Squadron provides personalized outpatient medical and dental care for the Brooks Air force Base community in a total quality environment. Services include primary care, aerospace medicine, optometry, military health, pharmacy, radiology, immunology, military public health, bioenvironmental engineering, and clinical laboratory. Approximately 25,000 patients per year are treated here.

United States Air Force

Air Force Center for Environmental Excellence, Brooks AFB, TX 78235, (210) 536-3066

March 1994 Fact Sheet No. 1

The Air Force Center for Environmental Excellence

The Air Force Center for Environmental Excellence, with headquarters at Brooks AFB, Texas, was established on July 23, 1991, to spearhead the Air Force's overall environmental program.

The Center, which has a staff consisting primarily of scientific and technical professionals, provides the service with an in-house capability to handle all aspects of environmental cleanup, planning and compliance, pollution prevention, and design and construction management.

AFCEE's five operational directorates and their responsibilities are:

■Construction Management provides design and construction management (DM/CM) services for all Military Construction (MILCON) projects for designated commands, including AF Space Command, Air Force Academy, AF Special Operations Command, AF Reserve, and AF field operating agencies.

The directorate also provides DM/CM services for all AF MILCON-funded industrial and domestic waste treatment facilities and all AF MILCON medical facilities within the continental United States (CONUS).

Finally, the directorate provides cradle-to-grave execution services for the AF Military Family Housing construction programs.

■Design Group provides commanders with a variety of professional services, including architectural, interior and landscape design; and base planning. The directorate fosters planning and design excellence by formulating policy, setting standards and executing sound planning and design principles.

■Environmental Conservation and Planning develops environmental impact statements and environmental assessments for Air Force bases associated with base closure and other selected programs.

It also provides expertise to non-closing installations on land-use planning and conservation of historical, archeological and biological resources. These include wetlands, threatened and endangered species, native American archeological sites and a variety of other specialty areas.

■Environmental Restoration provides management of all environmental restoration activities such as remedial investigations, remedial design, remedial actions and long-term operations for designated closure and non-closure bases.

The directorate also: provides technical oversight of environmental programs; laboratory quality assurance assessments; document reviews; assistance in selecting remediation technologies; and serves as the focal point for technology evaluation, application and transfer from the laboratory to the field.

■Pollution Prevention supports pollution-prevention and compliance programs worldwide. It also identifies pollution/compliance opportunities; provides contract management services; develops and executes strategic initiatives to identify and implement solutions to common Air Force pollution-prevention and compliance problems; and cross feeds information on successful programs, good ideas and "best available" technologies from throughout the Air Force and federal government.

The Center has three regional compliance offices located in Dallas, Atlanta and San Francisco. They are responsible for keeping Air Force commanders advised of and in compliance with all applicable environmental laws and regulations.

As a whole, the Center forms a comprehensive, professional team dedicated to providing a full range of design, construction and environmental services to Air Force commanders.

United States Air Force

FACT SHEET

Office of Public Affairs, Human Systems Center, 2510 Kennedy Circle, Suite 1,
Brooks AFB TX 78235-5120 Phone (210) 536-3234 Fax (210) 536-3235

HISTORY OF BROOKS AIR FORCE BASE

A history of Brooks (Field) Air Force Base is, in a real sense, a history of American Military Aviation. Brooks was a war baby, born of necessity to train pilots for World War I duty. Ground was broken for the facility on December 8, 1917, and it was formally established under the command of Major Henry C. Pratt on February 16, 1918.

Like a chameleon, Brooks has changed and adapted itself to the needs of the times, giving it varied and interesting missions. Its first mission was to train World War I pilots. After the war, it developed a Balloon and Airship School, but with the disasters of the airships, including the death of one of its commanders, its mission changed to become the Primary Flying School of the Air Corps. Charles A. Lindbergh was among its most notable graduates. The relocation of the School of Aviation Medicine to Brooks in 1926 was of great importance for the future of military aviation. Although it was moved to Randolph Field in 1931, it moved back to Brooks again in 1959.

In 1928, Brooks became the site of the first series of paratroop experiments conducted in the world. The value of this experimentation was proven time after time in World War II. From 1931-1939, the Field became a center of activity in aerial observation. During World War II, it once again became a pilot training ground. During the 14 years following World War II, Brooks was the site for a succession of tactical and reserve flying activities. The base served as the center for air evacuation flights.

An era in aviation history ended on June 20, 1960, when the last plane took off from the Brooks runway. But the end of flight operations also marked the beginning of a new era. Brooks became the headquarters for the newly established Aerospace Medical Center. By 1961, the Aerospace Medical Division (AMD) was established at Brooks under the Air Force Systems Command, and the mission of the Center was incorporated into that of the Division. On November 21, 1963, President John F. Kennedy, in the last official act of his presidency, dedicated a group of four newly constructed buildings in the complex that houses division headquarters and the USAF School of Aerospace Medicine.

(Current as of April 1994)

Once again the mission of Brooks shifted as emphasis was placed upon acquisition in human systems-related technology. To indicate this, AMD changed its name to the Human Systems Division on February 6, 1987.

On July 1, 1992, the Human Systems Division was renamed the Human Systems Center as part of the structuring of the new Air Force Materiel Command. The command was activated July 1, 1992, when the Air Force Logistics Command and Air Force Systems Command were integrated.

The history of Brooks AFB is reflected in a number of parks, buildings and street names which commemorate the various personalities that influenced this base and its mission. These men and women were of all ages and occupations. Some were killed in the line of duty, some were base commanders and others were of national acclaim.

United States Air Force

FACT SHEET

Office of Public Affairs, Human Systems Center, 2510 Kennedy Circle, Suite 1, Brooks AFB TX 78235-5120 Phone (210) 536-3234 Fax (210) 536-3235

HANGAR 9

Built in 1918, Hangar 9 was one of sixteen original hangars built at Brooks Field. Though constructed as a "temporary" facility, Hangar 9 remains the oldest wooden aircraft hangar in the United States Air Force. With a combined base and community effort, Hangar 9 was restored in 1969 and now houses the USAF Museum of Aerospace Medicine and other related exhibits depicting the history of Brooks Air Force Base. Unique exhibits include an original JN-4 aircraft, an Ocker Box, early flight surgeon and flight medicine artifacts, and the podium used by President John F. Kennedy for his last official address on Nov. 21, 1963. In 1970, Hangar 9 was dedicated as a memorial to Edward H. White II, a native of San Antonio, who was the first American to walk in space and who lost his life in the Apollo I capsule fire. Hangar 9 is included in the Texas State Historical Survey, is entered in the National Register of Historic Places and is a National Historic Landmark. The hangar holds a special place in the hearts of all who have served at Brooks. The windsock, still flying on the roof, is a constant reminder of the glory days of flying.

USAF AEROMEDICAL EVACUATION ANNEX

To commemorate the 75th anniversary of Brooks Air Force Base, the 75th anniversary of the School of Aviation/Aerospace Medicine and to honor 50 years of flight nursing, the Brooks Heritage Foundation moved, renovated, and refurbished a World War II barracks. During its 50 years at Brooks, the building served many functions including a dining hall and the base exchange shoppette. The building is now located alongside Hangar 9 and contains artifacts relating to the history of USAF aeromedical evacuation and flight nursing. A walkway, connecting the museum with the annex, displays the names of contributors. The annex was formally dedicated and opened on Nov. 13, 1992. The annex restoration project won the 1992 USAF Historic Building Preservation Award.