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USAF SCHOOL OF AEROSPACE MEDICINE

HARRY G. ARMSTRONG AEROSPACE MEDICAL RESEARCH LABORATORY

AMD DIRECTORATE OF SYSTEMS ACQUISITION

TECHNICAL PLANS DIVISION

JANUARY 1986

AEROSPACE MEDICAL DIVISION
AIR FORCE SYSTEMS COMMAND
BROOKS AFB, TEXAS 78235-5000

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This TOD describes the planning methodology used within two of AMD's laboratories to achieve our technical goals. Specifically, efforts are directed in the biotechnology program to man's adaptability, survivability, and performance capabilities within his operational environment. This research and development of AMD's functions is accomplished as interdisciplinary work by teams of biomedical scientists, engineers, and physical scientists within the Air Force laboratories and the industrial and academic communities.

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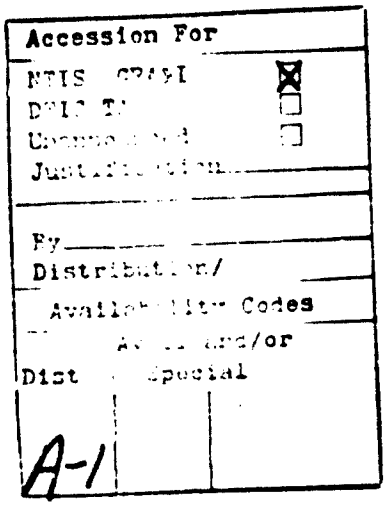


TABLE OF CONTENTS

INTRODUCTION

The Air Force Technical Objective Document (TOD) program is an integral part of the process by which the Air Force plans and formulates a detailed technology program to support the development and acquisition of Air Force weapon systems. Each Air Force laboratory annually develops plans in response to available guidance based on USAF requirements, the identification of scientific and technological opportunities, and the needs of present and projected systems. These plans include proposed efforts to achieve desired capabilities, to resolve known technical problems and to capitalize on new technical opportunities. The proposed efforts undergo a lengthy program formulation and review process. Generally, the criteria applied during the formulation and review are responsiveness to stated objectives and known requirements, scientific content and merit, program balance, developmental and life cycle costs, and consideration of payoff versus risk.

It is fully recognized that the development and accomplishment of the Air Force technical program is a product of the teamwork on the part of the Air Force laboratories and the industrial and academic research and development community. The TOD program is designed to provide to industry and the academic community necessary information on the Air Force laboratories' planned technology programs.

Specific objectives are:

a. To provide planning information for independent research and development programs.

b. To improve the quality of unsolicited proposals submitted to AMD and of R&D procurements.

c. To encourage face-to-face discussions among non-Government scientists and engineers and their Air Force counterparts.

One or more TODs have been prepared by each Air Force laboratory that has responsibility for a portion of the Air Force Technical Programs. Classified and limited distribution TODs are available to qualified users from the Defense Technical Information Center (DTIC) and unclassified TODs are available from the National Technical Information Service (NTIS).

As you read through the pages that follow, you may see a field of endeavor where your organization can contribute to the achievement of a specific technical goal. If so, you are invited to discuss your ideas with the scientist or engineer identified with that objective. Further, you may have completely new ideas not considered in this document which, if brought to the attention of the proper organization, may make a significant contribution to our military technology. We always maintain an open mind in evaluating new concepts which, when successfully pursued, would improve our future operational capability.

On behalf of the United States Air Force, you are invited to study the objectives listed in this document and to discuss them with the responsible Air Force personnel. Your ideas and proposals, whether in response to the TODs or not, are most welcome.

HOW TO USE THIS DOCUMENT

Unsolicited proposals to conduct programs leading to the attainment of any of the objectives presented in this document may be submitted directly to an Air Force organization. However, before submitting a formal proposal, we encourage you to discuss your approach with the laboratory point of contact. After your discussion or correspondence with the laboratory personnel, you will be better prepared to write your proposal.

As stated in the "AFSC Guide for Unsolicited Proposals," (copies of this informative guide on unsolicited proposals are available by writing to Air Force Systems Command/PMPR, Andrews Air Force Base, Washington, DC 20334), elaborate brochures or presentations are definitely not desired. Successful proposals should be accurate, brief, and clear. It is extremely important that your letter be prepared to encourage its reading, to facilitate its understanding, and to impart an appreciation of the ideas you desire to convey. Specifically, your letter should include the following:

1. Name and address of your organization.

2. Type of Organization (Profit, Nonprofit).

3. Concise title and abstract of the proposed research and a statement indicating that the submission is an unsolicited proposal.

4. An outline and discussion of the purpose of the research, the method of attack upon the problem, and the nature of the expected results.

5. Name and research experience of the principal investigator.

6. A suggestion as to the proposed starting and completion dates.

7. An outline of the proposed budget, including information on equipment, facility, and personnel requirements.

8. Names of any other Federal agencies receiving the proposal (this is extremely important).

9. Brief description of your facilities, particularly those which would be used in your proposed research effort.

10. Brief outline of your previous work and experience in the field.

11. If available, you should include a descriptive brochure and a financial statement.

MISSION

The Aerospace Medical Division (AMD), at Brooks AFB TX, is a major Air Force Systems Command (AFSC) organization composed of several diverse organizations with varying missions. These missions include operation of the Wilford Hall USAF Medical Center, field consultation services through the Occupational and Environmental Health Laboratory (OEHL), operation of the Air Force Drug Testing Laboratory, conduct of specialized biomedical education through the USAF School of Aerospace Medicine (USAFSAM), and research and development. All research and development programs are the responsibility of the AMD Deputy Commander for Research, Development and Acquisition and are managed through the USAF School of Aerospace Medicine (USAFSAM), the Harry G. Armstrong Aerospace Medical Research Laboratory (AAMRL), the Air Force Human Resources Laboratory (AFHRL), and the AMD Directorate of Systems Acquisition (AMD/RDS).

The research and development responsibility of AMD is to effectively integrate the human operator within the wide spectrum of Air Force systems and missions. These "human-centered" efforts span the full spectrum of research and development ranging from basic research through engineering development and are conducted via contract or within unique in-house facilities which allow real world Air Force environments to be simulated in the laboratory setting with the human operator as the central focus.

The program elements and projects managed by AMD are listed below. AFHRL has published a separate Technical Objectives Document (TOD) for its programs indicated by asterisks.

AMD PROGRAM ELEMENTS/PROJECTS

61102F DEFENSE RESEARCH SCIENCES

62202F AEROSPACE BIOTECHNOLOGY
2729 CHEMICAL DEFENSE
6302 TOXIC HAZARDS
6893 MANNED WEAPON SYSTEMS EFFECTIVENESS
7184 MAN-MACHINE INTEGRATION
7231 MECHANICAL FORCES
7755 AEROSPACE MEDICINE
7757 RADIATION HAZARDS
7930 ADVANCED CREW TECHNOLOGY

* 62205F TRAINING & SIMULATION TECHNOLOGY
1121 TECHNICAL TRAINING DEVELOPMENT
1123 FLYING TRAINING DEVELOPMENT
1192 ADVANCED SIMULATION FOR PILOT TRAINING
1710 LOGISTICS & MAINTENANCE TECHNOLOGY
3017 COMMAND & CONTROL TRAINING
6114 FLIGHT SIMULATOR TECHNOLOGY

* 62703F PERSONNEL UTILIZATION TECHNOLOGY

7719 FORCE ACQUISITION & DISTRIBUTION SYSTEM
7734 FORCE MANAGEMENT SYSTEM

* 63106F LOGISTICS SYSTEMS TECHNOLOGY
2940 COMPUTER TECHNOLOGY FOR DESIGN & MAINTENANCE
2950 INTEGRATED MAINTENANCE INFORMATION SYSTEM

* 63227F SIMULATOR TECHNOLOGY
2363 ADVANCED VISUAL TECHNOLOGY SYSTEM
2743 ADVANCED SIMULATOR CONCEPTS

63231F CREW SYSTEMS TECHNOLOGY
2829 COCKPIT AUTOMATION TECHNOLOGY (CAT)
2830 ADVANCED LIFE SUPPORT SYSTEMS (ALSS)
2868 CREW ESCAPE SYSTEMS TECHNOLOGY (CREST)
2992 SPACE CREW ENHANCEMENT

* 63704F MANPOWER & PERSONNEL SYSTEMS TECHNOLOGY
2922 PERSONNEL ASSESSMENT SYSTEMS
2948 OCCUPATIONAL ANALYSIS TECHNOLOGY
2949 BASIC SKILLS ASSESSMENT & ENHANCEMENT SYSTEM
2951 TRAINING DECISIONS SYSTEM

63723F CIVIL & ENVIRONMENTAL ENGINEERING TECHNOLOGY
3037 NOISE & SONIC BOOM IMPACT TECHNOLOGY

63745F CHEMICAL WARFARE DEFENSE
2722 BIOMEDICAL CHEMICAL WARFARE DEFENSE

* 63751F INNOVATIONS IN EDUCATION & TRAINING
2359 PILOT PERFORMANCE MANAGEMENT SYSTEM
2362 COMPUTER-BASED MAINTENANCE AIDS
2557 ADVANCED ON-THE-JOB TRAINING SYSTEM
2744 UNIFIED DATA BASE APPLICATION
2745 LOGISTICS FOR COMBAT READINESS MAINTENANCE
3056 AIR COMBAT ASSESSMENT & DEBRIEFING SYSTEM
3057 PORTABLE INTELLIGENT COMPUTER-ASSISTED INSTRUCTION

64227F FLIGHT SIMULATOR DEVELOPMENT
3135 ADVANCED TRAINING SYSTEM

64703F AEROMEDICAL/CHEMICAL DEFENSIVE SYSTEMS DEVELOPMENT

65306F RANCH HAND

* AFHRL MANAGED PROGRAMS

AEROSPACE MEDICAL DIVISION

INVESTMENT STRATEGY

1. With the reorganization of AMD as a product support division in March 1982 came the increasing responsibility to define and prioritize requirements and to improve technology transition to all of its customers. AMD intends to maintain a viable technology base program not mortgaged against the immediate need for technology solutions for today's problems. AMD's investment strategy recognizes that people-centered technologies pervade every Air Force program and field operation. Consequently, AMD's services are being used throughout AFSC, and several new programs will be coming on line which will further improve the human operator/system interface of Air Force systems.

2. USAFSAM, AAMRL, and AMD/RDS invest resources in three major thrust areas: Safety, Environmental & Medical; Crew Protection and Survivability; and Crew Systems Integration. Within these thrust areas, changes in program emphasis and planned initiatives include:

a. Emphasis on neurosciences

b. New approaches to identify and train pilots

c. Increased capability to define minimal coronary artery disease

d. Improved aircrew sudden incapacitation countermeasures

e. Night vision measurement and enhancement

f. Operator interface with machine intelligence

g. Experimental man-in-space

h. Relocatable target strike crew systems capability

i. Hypersonic escape concept exploration

j. Noise and sonic boom technology

k. Advanced control and display technology

p. Directed energy effect on transparent materials

3. Our programs are structured to provide significant payoffs for future Air Force capabilities. These programs require good user relationships and a strong advocacy base.

PE 62202F - Aerospace Biotechnology

Aerospace Biotechnology is the core Air Force technology base program to optimize the role of the human operator in the design, development, and operation of weapon systems. The five key thrusts for the biotechnology program are: (1) to improve the performance of the human component of weapon system/operations by refining crew selection and maintenance, crew protection, and man-machine integration; (2) to improve safety and environmental protection from radiation, chemical, and mechanical forces; (3) to establish threat characterization and countermeasures effectiveness against enemy weapon systems; (4) to develop chemical defense measures for airbase operations, casualty care evacuation, and personal protective equipment; and (5) to exploit and optimize man's utility in military space systems, and insure crew protection in military space environments. The products of this program are applied primarily to corollary hardware development programs in strategic offense and defense, tactical air superiority and interdiction, and command and control. Several key factors drive the increasing investment in this program: reliance on more technology-rich hardware systems to achieve increased aircraft performance; the requirement to reduce life cycle costs of weapon systems; and the national environmental concern with lifetime effects of exposure to various forms of radiation and chemicals. The technology base projects comprising this program are briefly described below.

Project 2729 - Chemical Defense

In accordance with the Joint Service Agreement (JSA) of 1984, the US Army is the DOD executive agent for research, exploratory and advanced development projects for chemical weapons as well as chemical and biological defense (CW/CBD). The Air Force plans, programs, budgets, funds and performs an exploratory development project to meet specific Air Force requirements in chemical warfare defense (CWD). This project is fully coordinated with the other services RDT&E projects and is reviewed regularly by the JSA CW/CBD Review Group (JSRG) as well as the Armed Services Biomedical Evaluation and Management Committee (ASBREM). The latter group insures integration of DOD projects to meet medical RDT&E requirements of the three services. The Air Force exploratory development project has work underway in seven main thrust areas: detection; individual protective equipment; collective protection; contamination control; medical operations analysis and equipment; CW drugs and performance; and air forces operations analysis. Efforts of the scientists, engineers and technicians involved in this technology base project will enhance the effectiveness of air forces operations and aeromedical care in the event of a chemical agent attack. Products of this effort include development of technology, concepts, procedures and analyses of: current and next generation protective equipment; detection; identification and warning devices; decontamination and contamination avoidance equipment and procedures; chemical warfare protection (prophylactic and therapeutic) drugs on air and ground crew performance; aeromedical equipment and procedures; and air forces operations in a chemical warfare environment. Among the activities in the current (FY86) program are the following:

(1) Evaluation of detector technologies for incorporation into individual and collective protection.

(2) Development of capability to use heart and respiratory sounds for assessment of casualty status.

(3) Feasibility of binding agents and hydrolyzing enzymes for incorporation into dressings for wounded casualties to protect and/or reduce effects of nerve agents.

(4) Development of don/doff concepts for use in mobile and survivable collective protection facilities.

(5) Improvements in concepts and procedures for processing casualties.

(6) Development of concepts for powered ground crew protective masks in a chemical warfare environment.

(7) Identification of workloads imposed on personnel performing mission critical tasks (e.g., security police and medical decontamination teams) under simulated CBD conditions.

(8) Evaluation of breadboard models for individual and collective cooling of personnel in chemical defense ensembles.

(9) Determination of the impact that nerve agents and/or protective (prophylactic and therapeutic) drugs have on physiological, cognitive and physical performance in animal models.

(10) Enhancement of CW data base and existing CW models for estimates of airbase survivability.

(11) Identification of compounds suitable for simulating persistent nerve agents.

(12) Development of concepts and breadboard models for improved communications among personnel enclosed within chemical defense ensembles.

(13) Development of a field usable vision test device for assessment of aircrew performance capability.

(14) Development of standardized performance assessment batteries for use by DOD R&D programs evaluating CW protective drugs on performance of mission critical tasks.

(15) Evaluation of the impact of pyridostigmine on performance when coupled with altitude, acceleration and disorientation stresses of tactical air missions.

(16) Evaluation of the impact of pyridostigmine on performance of aircrew tasks critical to tactical air missions.

(17) Development of methodology to evaluate the impact of procedures and equipment used in the chemical warfare environment on performance of airbase maintenance operations.

Products of these technology base efforts transition into advanced development work when results warrant or they may feed into further exploratory development work. On occasion results are of immediate use to user commands. Decisions on the route taken by these products are coordinated by project and task managers with other RDT&E and user communities. In addition, manpower and facilities funded by this project provide consultation and assessment support to advanced and engineering development programs as well as agencies outside the USAF RDT&E community.

FY 87-91 Emphasis: During this timeframe efforts underway in this project will continue to enhance USAF capability to conduct missions in the CW environment. Taking advantage of evolving technologies and data related to the major thrust areas, new efforts will be initiated depending on availability of funds and expertise: In each case prior coordination will be undertaken within the JSRG and ASBREM. Efforts will continue to (1) improve don/doff and casualty processing procedures for integration with advances in the collective protection facilities (2) develop suitable detection devices for use on individuals as well as in collective protection facilities (3) assess the impact of chemical defense ensembles on workloads of personnel performing mission critical tasks (4) develop better guidelines of hydration and work cycles for these personnel through the use of nonhuman models (5) establish a data base on the effects of low doses of nerve agents (6) improve capability for estimates on airbase operations in a CW environment (7) develop an advanced physiologically-based pharmacokinetic model for uptake and distribution of chemical agents (8) develop an improved communications capability based on infra-red technology (9) evaluate the possible effects of chemical protective drugs on performance of air and ground crews tasks (10) develop guidance to commanders on limitations and capabilities of personnel in chemical defense ensembles to perform airbase maintenance operations. Output of these future efforts will be utilized in a similar fashion as described previously.

Project 6302 - Occupational and Environmental Toxic Hazards in Air Force Operations

This project maintains sole research and development responsibility within the Air Force for the toxicological assessment of Air Force materials and critical processes that may be associated with advanced Air Force systems operations. Activities include: systematic studies of toxic hazards; determination of biological, toxicokinetic, and pharmacological bases of toxicity; establishment of human exposure criteria for engineering design; determination of exposures effects on performance; identification of potential environmental toxicology problems; and development of toxicologic methodologies and protocols. Acute, chronic, teratogenic, and long-term oncogenic studies are performed.

In the current program, health exposure criteria will be established for the synthetically derived carbon-slurry fuel and dermal hazard evaluation of hydrazine will be conducted. Toxicokinetic modeling efforts will be extended to include mixed hydrocarbon exposures. Toxicological studies on metallic slurries (high-energy fuel) will be continued. Studies will be initiated to assess health hazards associated with groundwater contaminants and recommendations will be made with respect to appropriate action levels.

FY 87-91 Emphasis: Toxicological exposure studies for metallic slurry fuels will be completed. Work to establish appropriate exposure criteria for shale JP-4 will be continued. Efforts will be continued to couple toxicokinetic modeling with pharmacodynamics to arrive at dose-response relationships. Work will be continued to assess a wide variety of Air Force industrial chemicals and materials (e.g., hydraulic fluids, lubricants) with respect to health exposure criteria.

Project 6893 - Manned Weapons System Effectiveness

This project determines and evaluates the interactive effects of crew performance on manned weapon systems survivability, threat system effectiveness and human countermeasure capabilities for use in system concept definition and design. It incorporates man-in-the-loop and computer simulation procedures for assessing the merit of competing manned weapon and threat system designs; develops effective countermeasures against threat crew systems; and develops effective camouflage, concealment, and deception mechanisms.

In the current program, workload measurement technologies are being applied to C^3 systems and an optimized, standardized C^3 crewstation is being developed. Efforts are progressing in countermeasures technology for threat C^3 systems and a dedicated human engineering effort addressing manned functions in space has been established. Work is in progress on a series of space visual function testers and work is nearing completion on radar decoy effectiveness simulations. The development of technology for an optically based terrain avoidance/terrain following (TA/TF) system is continuing, as are investigations of low energy laser countermeasures on aircrew performance.

FY 87-91 Emphasis: During this timeframe this project will be characterized by increasing definition of man's role in space with emphasis on man-in-space performance technologies. Activities concerning concealment, camouflage, and deception (CCD) should peak in the FY 89 - FY 90 timeframe and proceed to completion in FY 91. Increasing effort will also be directed toward the application of artificial intelligence technology to cockpit management of threat information. The radar decoy design system and the airbase visual deception system technology are projected to be complete in FY 89. The total CCD package should be integrated into the airbase multisensor deception system technologies package by FY 91. A generic ground-to-air threat simulation system will be achieved by the end of FY 90 and a pilot model system will be achieved by the end of FY 91. This unique simulation capability would enable AAMRL to research the complex interactions that take place between the aircrew and the threat crew. C^3 system research will also peak in the FY 88 - FY 89 timeframe. Work should be completed on the "standard" C^3 crew station during FY 87. Adaptive decision aiding should be incorporated in FY 88 and the efforts toward optimized crew performance C^3 centers will be completed in FY 89.

Project 7184 - Man-Machine Integration Technology

This project develops methodologies and technologies to maximize the efficiency and effectiveness of the human operator interface with Air Force systems. Low-level, high-speed flight profiles, high threat densities, and night in-weather operations critically impact manned system performance and hence,

mission success. Basic information about the perceptual, cognitive, and response characteristics of human operators is developed within mission-specific scenarios. This data drives the development of new concepts and establishes human-centered design criteria. Standardized methodologies are also developed to assess the improvement in weapon system performance due to optimized man-machine coupling.

During the current year's program, work will continue on development of the Army Light Attack Helicopter (LHX) virtual image cockpit, design simulations for the B-1B defensive stations, and the chemical defense modelling efforts will continue on the DARPA artificial intelligence based pilots' associate system, and the relocatable targets program.

FY 87-91 Emphasis: The project will continue its current work of developing virtual cockpit displays for the Army LHX and should be complete about FY 90. Concurrently, work will also entail the development of helmet-mounted display applications for tactical fighter aircraft. This effort should also be completed during FY 90. Other long-range objectives include completion of the workload military specification during FY 87. In FY 88, an extensive effort, under Army sponsorship, will be completed to develop a standard drug screening performance test battery. In FY 89, the joint effort with the Air Force Human Resources Laboratory to develop a computer assisted design capability for aircraft maintenance tasks will be completed and validated. Additionally, in conjunction with project 6893, work to develop a standardized C^3 crew station will culminate in a design guide for C^3 workstations in FY 87.

Project 7231 - Safety and Aircrew Effectiveness in Mechanical Force Environments

This project develops the information and equipment needed for mission effectiveness, safety, and health of personnel exposed to hazardous mechanical forces created by Air Force ground and flight operations. These forces include sustained and impact acceleration, vibration, and noise. Tasks within this project include advanced escape/ejection technology, advanced voice communications/jamming technology, environmental noise technology, sustained acceleration protective systems, impact injury research, and advanced dynamic modeling of impact acceleration. The information developed in this program is translated into human-centered technology which facilitates the development of advanced aircrew escape/ejections, advanced aircrew restraint systems, operator-centered communications and communications jamming systems, environmental noise exposure criteria, and sustained acceleration protective systems.

Current year efforts will: (1) continue research and development to provide technology for a very high speed, "high mach" ejection system, and translate this data to a new start to evaluate hypersonic escape and rescue, (2) research to optimize voice communications in narrow channel digital communications systems, (3) continue the environmental noise/sonic boom evaluations for supersonic training areas, and (4) continue pilot incapacitation warning systems development and advanced manikin development.

FY 87-91 Emphasis: Support efforts for the development of advanced (engineering development) ejection system and advanced environmental noise/sonic boom programs will continue. Human-centered R&D efforts in communications, communi-

cations jamming, and voice activation systems technology will be expanded to develop an in-depth technology base and technical center. Sustained impact accelaration research efforts will increase to provide R&D and test technology for advanced cockpit/ejection seat designs. These technologies will form the basis for future advanced development programs which will focus on projected year 2010 operations.

Project 7755 - Aerospace Medicine

This project develops methods to ensure: (1) the best medical selection criteria are applied to applicants for Air Force Undergraduate Pilot and Navigator Training; (2) detection and prediction of the early onset of disease aviators; and (3) refinement of retention criteria to optimize and increase the "cockpit longevity" of Air Force flyers.

During the current year coronary artery disease predictive models will be completed; prototype situational awareness training protocols will be developed; new waivers and follow-up criteria for mitral valve prolapse will be defined; and night vision measurement and enhancement studies will begin.

FY 87-91 Emphasis: The capability to measure coronary perfusion and myocardial performance under G stress will be acquired. This technology addresses operational concerns of loss of consciousness for rapid high-G loading in high-performance aircraft. An Air Force risk index as a first-order screen for coronary artery disease will be promulgated. This will greatly impact aircrew selection with cost savings to the Air Force. Studies using digital subtraction angiography and the accomplishment of a Holter monitoring data base will contribute to this goal. State-of-the-art biotechnology will continue to be investigated to improve aircrew selection and retention.

Project 7757 - Radiation Hazards in Aerospace Operations

This program assesses biological hazards, develops countermeasures and quantifies acute and delayed biological effects of radiofrequency, ionizing, laser, nuclear flash, and particulate radiation on Air Force personnel. It performs personnel hazard assessments, defines safe separation distances, develops protective devices, and develops the means to predict air and ground crews' ability to maximally perform in laser, radiofrequency, or nuclear radiation environments.

During the current year, studies to determine the health effects of millimeter waves, VLF hazard studies and long-term, low-level RFR bioeffects studies will continue. Development of methods for assessing the aircrew performance decrements associated with combined ionizing radiation and dilute chemical agents and an effort to develop an ionizing radiation model for space crew sickness will be continued. Development of countermeasures methods and devices for crew protection from laser radiation will be continued and the visual function degradation associated with laser radiation will be determined. Nuclear fallout dose mitigation studies also will be continued.

FY 87-91 Emphasis: Efforts will be continued to develop directed energy health effects criteria for repetitively pulsed laser energy, high-energy pulsed radio frequency radiation, and particle beam radiation. Studies will be continued on the nuclear (non-directed) bioeffects/performance effects with respect to

aircrew vulnerability. The Post Attack Command and Control (PACC's) National Emergency Airborne Command Post (NEACP) dose fallout mitigation work will be continued. Efforts on the development of laser countermeasure devices/materials will be continued.

Project 7930 - Advanced Crew Technology

This effort provides biotechnology and applied physiology to ensure the protection and effective use of Air Force crews for advanced and future weapon systems. Current and future mission requirements dictate that weapon systems function in an increasingly threatening environment. This results in diverse needs for crew altitude, thermal, and acceleration protection that are often inadequate in current systems. Effort supports goals of: (1) advancing life support equipment to fulfill current and future Air Force requirements; (2) advancing aeromedical evacuation systems and related Air Force specific medical systems; and, (3) maintaining a current technology base. The overall goals of this objective are to develop breadboard systems or procedures that can be transferred to appropriate advanced development agencies with reasonable confidence of success.

Current year efforts will include the development of advanced research capability to evaluate tissue oxygenation during acceleration and altitude exposure and to utilize this technology to formulate test methodologies and criteria for life support systems. In addition efforts will be initiated to expand high altitude research programs with a primairy emphasis on laboratory development and a transition to Air Force operational applications. Sustained acceleration research will continue to develop protective equipment and procedures. Application of workload/performance research to improve sustained combat capability will be developed for a new start consideration.

FY 87-91 Emphasis: The initial phases of the five-year plan will be concentrated on the development of methods and mechanisms to facilitate the testing and evaluation of advanced life support equipment while minimizing the impact on high priority research activities. R&D efforts will increasingly emphasize methods to improve physiological performance while reducing the burden imposed by life support equipment. Mechanisms and evaluation procedures established for the evaluation of chemical defense prophylaxis and treatment drugs will be modified to include other pharmacologic intervention technique. Evaluations of human tolerance to high onset sustained acelerations, hypoxia decompression sickness, and spatial disorientation will provide basic information for life support equipment development and trade off.

PE 63231F - Crew Systems Technology

Project 2829 - Cockpit Automation Technology (CAT)

The CAT project is directed at developing and demonstrating a crew system design process with initial application to fighter/attack weapon systems. The project springs from the increasingly critical need to manage and integrate the pilot/aircraft interface in a more systematic and scientific way and to forestall crew systems integration problems noted in recent aircraft. Current design practices available for the crew system are general-if not antiquated. They focus primarily on control/display layout arrangements and lead to anthropometric studies, limited form/fit/function mock-ups, part-task

simulations and use operational pilots as advisors and test subjects as they are available. This approach is highly subjective, applied in a piecemeal fashion, and often not extensively used until full-scale engineering development. As a result, major cockpit human factors problems requiring both hardware and software re-work do not come to light until the flight test phase of development. This leads to significant engineering changes prior to fielding the aircraft. A second critical factor leading to the CAT Project is the rapid proliferation of technology due to the threat we face and the increasingly complex and sophisticated systems we develop to counter any threat. In recent years a myriad of avionics, sensors, weapons, automation concepts, and technologies have been developed. These applications are digitally intense, software controlled and lead to the potential for extremely capable weapon systems. To realize this potential requires an effective cockpit crew system. However, with current methods we are building a performance capability able to completely overwhelm the pilot with information, automation, and performance he can't use. The goal is to devise a formal design process that will determine the proper application of automation technologies based on combat performance requirements, pilot capabilities, and cost. When fully developed, the CAT process will be useful both for the initial configuration development and for managing cockpit changes during the system lifetime. The project concentrates on a fundamentally new approach to developing cockpit crew systems, including cockpit architecture, hardware, software, and integration with the air vehicle and related subsystem. Two primary products from this work are: (1) a structured crew system design process, and (2) a specific crew system design, tested through ground-based...real-time...tactical mission simulation. The CAT Project was devised from the outset to facilitate transition of the resulting technology. The primary Air Force customers for products from the CAT project reside in the Aeronautical Systems Division in the Deputy for Engineering and in the System Program Offices. Specifically, the CAT design process is being developed to be generalizable beyond the fighter application and may be hosted using an interactive designer workstation (based on computer-aided design/engineering technology) that can be physically installed at ASD/EN, SPO and industry locations. For the fighter application, the primary user for CAT products is the Advanced Tactical Fighter (ATF) project.

FY 87-91 Emphasis: Phase II dual contract awards are scheduled for early CY 86. The selection of a single Phase II contractor is planned for FY 88.

Project 2830 - Advanced Life Support Systems (ALSS)

The overall objective of the ALSS program is to develop and demonstrate an integrated life support system. The payoffs of such a system include reduced physiological restrictions on aircraft operational performance and enhanced probability of mission success. Current problems in life support equipment development stem from new mission requirements and aircraft performance which far exceed man's ability to remain an integral part of the weapon system. Life support equipment has historically been developed piecemeal with little thought for systems engineering principles or integration. As a result, current equipment is restrictive, cumbersome, and unable to meet present mission requirements. The first major effort is the Tactical Life Support System (TLSS) which is the first fully integrated life support system that addresses physiological requirements in future high-performance aircraft. The system provides: (1) "get-me-down" capability from 60,000 feet utilizing a Molecular Sieve Oxygen Generation System (MSOGS), positive pressure breathing regulator,

low profile mask, and chest counterpressure garment; (2) acceleration protection to $+9G_z$ using a quick response electroservo anti-G valve coupled with positive pressure breathing and expanded G-suit coverage; (3) integrated Chemical Defense (CD) protection to include a filter/blower system and vapor absorbent materials, a lightweight helmet which interfaces with laser protective visors and flashblindness goggles, and liquid torso cooling through the use of a liquid chiller and transport loop built into the torso garment.

FY 87-91 Emphasis: Final report and transition to full-scale engineering development is scheduled for 1987. The ALSS second generation effort will integrate advances in areas such as multi-wavelength laser eye protection, night vision enhancement, and flashblindness protection. Altitude and acceleration protection are expected to take advantage of new breathing system technologies to further expand the human performance envelope. A major task will be oriented toward the integration of life support equipment with advanced cockpit controls/displays and egress equipment.

Project 2868 - Crew Escape Technologies (CREST)

The objective of the CREST program is to develop advanced crew escape technologies to reduce the fatality and major injury rates of ejections from advanced aircraft. The application of these technologies will ultimately (1) provide improved crew protection during aircraft flight maneuvers and after departure from controlled flight, (2) minimize the major injury and fatality rate associated with emergency escape under adverse airspeed, altitude, attitude, and acceleration conditions, and (3) reduce the cost of ownership of escape systems.

A fundamental purpose of this program is to develop and demonstrate a new adaptive performance approach for emergency escape systems operation. This approach is required to meet the wide range of escape environmental conditions associated with contemporary and future high-performance aircraft (such as the Advanced Tactical Fighter). Ongoing exploratory development efforts and concept definitions in the areas of adaptive restraint, windblast protection, selectable thrust/attitude control rockets, digital flight control for stability and steering, controllable catapult, and advanced sensors shall form the basis for selection of critical subsystems and their advanced development.

FY 87-91 Emphasis: Critical design review is scheduled for FY 88, followed by testing in FY 88 and FY 89 and the Functional Configuration Audit in FY 89.

Project 2992 - Space Crew Enhancement

The AMD man-in-space program will address two major functional areas relating to Air Force space crews. These are crew protection and man-machine integration which are directed at exploiting and optimizing man's ability in military space systems. In the crew protection function, the objective is to ensure crew protection and survivability in the military space-based environment. With respect to man-machine integration, the objective is to enhace man's integration into military space systems whether he is ground or space based.

FY 87-91 Emphasis: Early efforts will include the development of man-in-the-loop visual acquisition and tracking systems, the study of Space Adaptation Syndrome and its effects on military missions, and investigations of space suit requirements for the Advanced Aerospace Vehicle (AAV). Later efforts will expand to include radiation and mechanical force hazard definition and protection.

PE 63723F - Civil and Environmental Engineering Technology

Project 3037 - Noise and Sonic Boom Impact Technology (NSBIT)

The Air Force, with an expanding inventory of supersonic aircraft, and with increased flying hours and changed mission requirements of flying faster, lower, and over every conceivable type of terrain, has generated increasing public concern about conflicts with other airspace users and with land uses beneath Air Force operational flying areas. To sustain the Air Force's ability to conduct operations at airfields, weapons ranges, and other operational areas, it is vital that the Air Force be capable of addressing successfully environmental requirements which have surfaced with the passage of the National Environmental Policy Act of 1969, and do so in a timely manner. This effort addresses the broad spectrum of actions available to the USAF to reduce public concern, mitigate litigation, and promote timely and efficient conduct of Air Force flying missions. This development effort is being coordinated with the National Academy of Science and NASA, FAA, and EPA to ensure adequately defensible products are obtained and to ensure optimum use of interagency resources. The program is responsive to DoD identification of the Air Force as lead service for sonic booms and to Air Staff Statement of Need 1-81.

FY 87-91 Emphasis: A development plan was initiated in FY 85 to identify the manner, priority, and areas for work in the FY 87-91 time frame. The FY 86 program will include the beginning of modeling, monitoring and human effects studies with studies for structures and animals to follow in FY 87 and 88 respectively. Finally, effectiveness of barriers will be studied in FY 89 as well as development of a boom monitoring network. A validation effort for the entire program will be initiated in FY 89 and completed in FY 90.

PE 63745F - Chemical Warfare Defense

Project 2722 - Biomedical Chemical Warfare Defense

This project is the advanced development continuation of those efforts originating from AMD Project 2729, previously outlined, as well as the initiation of more advanced technology research. The AMD 6.3 program is directed at unique biomedical problems in the areas of individual protection, collective protection, detection, identification and warning, contamination control, and medical systems.

FY 87-91 Emphasis: Individual Protection will emphasize the advanced development of Aircrew Eye/Respiratory Protection (AERP) efforts. This will include analysis of cockpit, life support, and procedures modifications. Non-ice/slush backpack cooling systems will also be investigated and advanced to provide an alternative to, or work in conjunction with, improved aircrew fabric development. Collective Protection will emphasize the advanced development of cockpit filtration through the use of Molecular Sieve Oxygen Generation Systems (MSOGS). Technologies in fixed/mobile shelter will be investigated and developed as well. Detection and Warning will emphasize the development of chemical agent detectors for airbase and aircraft applications. This will include developing small, low cost/power detectors for aerosol, vapor, and liquid agent contamination. Contamination Control will emphasize the systems analysis of airbase contamination control and the development of hardware to efficiently decontaminate or harden USAF equipment required for sortie generation. Medical Systems will emphasize advanced technology development of methodologies and equipment for chemical casualty care to be used at each of the four echelons of medical care and in aeromedical evacuation.

PE 64227 - Flight Simulator Development

Project 3135 - Advanced Training System

The Advanced Training System (ATS) is a large scale training system using a family of computers along with exportable courseware. It will provide specifications for a compatible field on the job training system. MAJCOMs will be provided with tailored specifications.

The reasoning behind the program is that currently the lengthy time needed for the acquisition and training of instructors limits the capability to accomodate rapid student production surges in response to readiness or other force needs. The basic function of the program is to develop, deliver, and manage all the courses. The development includes writing the lessons, developing simulations/graphics, and organizing course structure. Delivery involves displays such as text, graphics, video disks, and others. Organizing a schedule, making tests and reports will fall under the management of the program. The ATS design shall be as modular as possible with every effort made to use off the shelf and existing systems and capabilities to minimize cost.

FY 87-91 Emphasis: AFSC will design, develop, test, acquire, and deploy the Advanced Training System for ATC use. Also AFSC in conjunction with MAC, SAC, TAC, SPACECMD, and AFCC will plan, program, and budget for the design and application of ATS to each of their training requirements. Program Management Responsibility Transfer of equipment/systems will occur on an incremental basis. The prototype installation is set for Dec 88.

PE 64703F - Aeromedical/Chemical Defensive Systems Development

The objective of this program is to provide aeromedical evacuation and casualty care equipment/systems to treat and evacuate wartime casualties. It is the only Air Force program established to conduct this type of research and to procure medical equipment to meet unique Air Force needs.

FY 87-91 Emphasis: Initial production continues for aeromedical evacuation programs under this effort and production of the ambulatory patient suit will occur in FY 88. Production of the Survivable Collective Protection System-Medical will occur in FY 89.

PE 64706F - Life Support System

Project 3111 - Aircraft Mishap Prevention

This engineering development new start will transition a laboratory-developed system to provide a centralized human factors data base, mishap data base and an information analysis and dissemination system to the Air Force Inspection and Safety Center. Currently, human factors are involved in 50 to 80% of all Air Force mishaps. The purpose of the AMP (Aircraft Mishap Prevention) program is to analyze and provide information to operational commands and research activities which can be used to improve aircraft design and operations. The AMP program will consist of computer hardware, software, human factors information and an information analysis and distribution system.

Efforts this year will include the establishment of a program management office and the development of trade studies to determine appropriate equipment and plans.

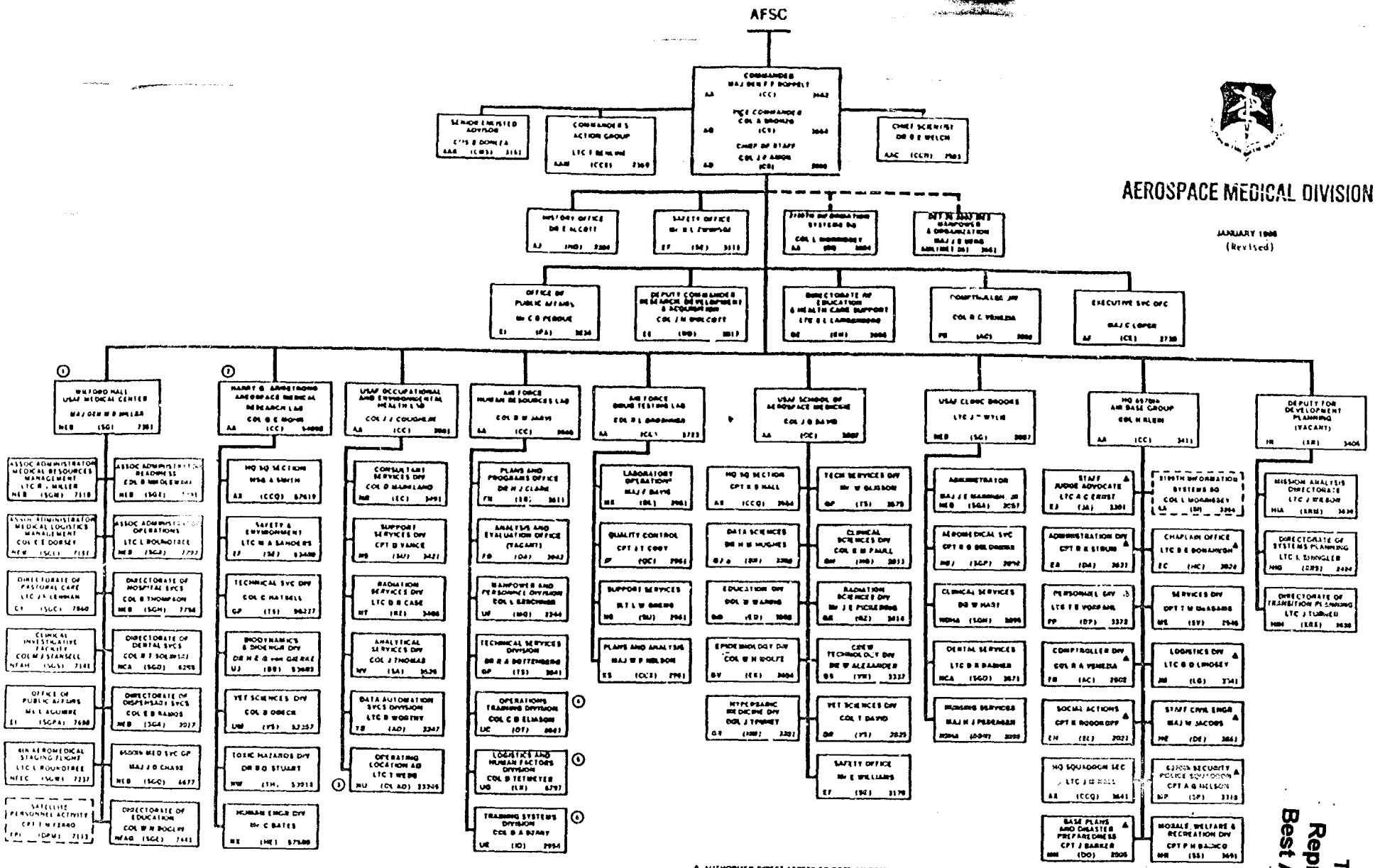
FY87-91 Emphasis: Through this time period, the AMP program will purchase and install computer hardware, develop software, conduct task analysis studies to fill gaps in the human factors data base, develop a systems operations team, and conduct developmental and operational testing. The program will transition to the Air Force Inspection and Safety Center in FY91.

PE 65306F - Ranch Hand II Epidemiology Study

Project 2767 - Ranch Hand II

The Air Force, under direction of the White House, is conducting a 20-year epidemiologic investigation of the possible adverse health in Air Force personnel who were involved with aerial dissemination of herbicides in Vietnam from 1962 to 1971 (OPERATION RANCH HAND). The objective of this investigation is to determine whether long-term health effects exist and can be attributed to occupational exposure to phenoxy herbicides and their associated dioxins. The extensive use of these herbicides in Vietnam was terminated in 1970 when it became known that 2,3,7,8 tetrachlorodibenzopardioxin (TCDD), a contaminant present in 2,4,5-T-containing herbicides, caused congenital abnormalities when administered to pregnant rodents. Only recently have comprehensive prospective studies in humans been undertaken. The baseline mortality and morbidity reports were published in June 1983 and February 1984.

FY 87-91 Emphasis: Three and five-year physical examinations will be conducted in concert with additional data gathering from questionnaires. Annual mortality reports will continue and a morbidity report is due by September 1989.



▲ AUTHORIZED DIRECT ACCESS TO DIVISION COMMANDER

LOCATION	ZIP	AREA CODE	COMMERCIAL	AUTOVON
BROOKS AFB, TEXAS	78235	512	536 & EX	240 & EX
(1) LACKLAND AFB TEXAS	78236	512	670 & EX	240 & EX
(2) WRIGHT PATTERSON AFB OHIO	45433	513	257 & EX	78 & EX
(3) CLARK AFB PI				822 5101 & EX
(4) WILLIAMS AFB AZ	85224	602	964 & EX	474 & EX
(5) WPAFB OH	45433	513	255 & EX	785 & EX
(6) LOWRY AFB CO	80230	303	304 & EX	

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