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U.S. Army's Aviation Life Support Equipment Retrieval Program

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In 1972, the U.S. Army Aeromedical Research Laboratory (USAARL) established the Aviation Life Support Equipment Retrieval Program (ALSERP). The purpose of this program is to evaluate the effectiveness of aviation protective equipment in an aircraft accident environment and to contribute to the improvement of this equipment through modification or development of new design criteria. Department of the Army Pamphlet 385-40, Army Accident Investigation and Reporting, requires all life support equipment which is in any way implicated in the cause or prevention of injury to be shipped to USAARL for analysis. The primary objectives of the ALSERP are (a) to determine why aviation mishap occupant injuries were or were not received, and (b) to develop concepts and criteria for design improvements through the analysis of injuries and their correlation to retrieved aviation life support equipment.

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Introduction

The primary objectives of the Aviation Life Support Equipment Retrieval Program (ALSERP) are: (a) to determine why aviation mishap occupant injuries were or were not incurred and (b) to develop concepts and criteria for design improvements through the analysis of injuries and their correlation to retrieved aviation life support equipment (ALSE).

Two ultimate goals of the ALSERP are: (1) To maintain and increase the level of protection during aircraft mishaps by collating and presenting clear injury and equipment failure data and trends to substantiate design improvements; and (2) the exploration of design alternative concepts for the mitigation and reduction of crash induced injury.

People are the Army's most valuable resource (FlightFax, 1994). This is especially true in aviation where the cost of training and maintaining a force capable of operating 24 hours a day around the world represents a major budgetary and time investment. With the downward trend in military budgets over the last few years and the associated difficulty of replacing soldiers lost due to injury and death, the senior leadership of the Army continually challenges us to find ways to preserve the fighting force (FlightFax, 1994). The mitigation and reduction of crash-induced injury becomes increasingly important as we work to protect the force by enhancing health, safety, combat effectiveness, and survivability of the soldier. Real world design successes from proactive investigation performed by ALSERP researchers complement the Army's effort to reduce the severity of injury and loss of life incidents resulting from aviation accidents (appendix A) (Licina and Sippo, 1992).

Background

The U.S. Army established credibility in trauma research related to the aviation environment through several studies. The first, published in 1961 by the U.S. Army Board for Aviation Accident Research (USABAAR) (Bezreh, 1961), identified 1214 major aviation accidents from July 1957 through December 1960, comprising 571 fixed wing and 628 rotary-wing aircraft. The study showed that 96.5 percent of the fixed wing and 97.7 percent of the rotary-wing accidents were considered survivable. This first definitive self-examination of U.S. Army aviation survivability discussed the aircraft inventory, postcrash fire experience, crash helmet experience, and expected future injury patterns. The report prompted further inquires from the field on life support equipment (LSE), crashworthiness, postcrash fire, and survivability. It also provided the aviation crewmember population with a proven reason to wear the APH-5 protective helmet which had not been totally accepted even though it had been in the Army inventory since 1958 (Aviation Digest, 1958).

Ten years later, two additional reports published served as the catalyst in establishing an aviation accident and ALSE program. The first dealt with the costs of training, maintaining, and replacing the Army aviator (Zilioli, 1971a); the second covered injury and death costs in Army UH-1 accidents during a single fiscal year (Zilioli, 1971b). The economic reality of the hidden costs associated with accidents was identifiable as a tangible fact that transcended the uncertain payback often associated with research.

Until the publication of these first reports, the Army aviation accident investigation effort was structured to explain the loss, identify the hazards, and provide appropriate countermeasures to the responsible parties and the chain of command. The missing components in this endeavor were the ability to catalog, categorize, and analyze these data for trends that could validate the data and make it germane to the community which it served.

In 1972, the U.S. Army Aeromedical Research Laboratory (USAARL) established the ALSERP based on regulatory authority of Army Regulation 95-5, "Aircraft accident prevention, investigation and reporting (Dept of the Army, 1975). The purpose of this program was to evaluate and record the efficiency of ALSE in the aircraft accident environment, focusing primarily on rotary-wing aircraft. The initial program was based on accident record analyses, but soon it was realized that the physical examination of the actual ALSE involved in aviation mishaps was necessary. Laboratory-based physical examination of helmets and other accident artifacts allowed a more detailed analysis by a selected interdisciplinary team of experts. It also provided for accurate laboratory impact replication of the damage when desired. Thus, the program matured to its current focus of correlating personal injury data with the particular item of LSE provided for protection, along with information on the accident kinematics and dynamics. ALSE items were assessed for damage to determine if the design was adequate, if it was manufactured to design specifications, or if it was worn properly by the crewmember. USAARL used these data to identify design deficiencies and to substantiate the need for system improvements. The LSE sent to USAARL for analysis included: helmets, flight suits, survival vests, gloves, boots, restraint systems, and later, inertia reels and crashworthy seats. The helmet is the primary ALSE item received by USAARL due to the identified incidence and criticality of head trauma experienced in aviation mishaps (Bezreh, 1961).

The ALSERP grew into a multi-service effort. In 1979, a memorandum of agreement (MOA) was signed with the U.S. Navy Aerospace Medical Research Laboratory and the U.S. Air Force Inspection and Safety Center at Kelly Air Force Base, Texas, for the submission of crash damaged helmets to USAARL for analysis, with the aim of forming a tri-service database on aviation rotary-wing crewmember helmet performance (Sippo, unpublished). The U.S. Coast Guard, Department of the Interior, and other government agencies submit helmets for analysis as they feel necessary.

To the extent possible, USAARL participates in all crash site assessments in addition to lab review to ensure that all aspects of human exposure and tolerances to external forces are understood and taken into consideration during case deliberations.

Specific regulatory guidance guarantees viability of the program. Regulation titles have changed, but ALSERP maintains its authority today in Department of the Army Pamphlet

385-40, Army accident investigation and reporting (1983). In addition, ALSERP team members, recognized for their assistance and expertise on matters pertaining to crash injury correlation, move freely within the safety channels as a result of a memorandum of understanding (MOU) with the U.S. Army Safety Center (USASC) (MOU, 1991). Both USAARL and the USASC Central Accident Investigation (CAI) team benefit greatly from their ability to share data, information, expertise, and material from aviation mishaps.

Materials and methods

ALSERP policies, operating procedures, equipment, materials and methods are outlined in USAARL Policy No. 95-55, "Aviation life support equipment retrieval program" (Appendix B). Physical collection of ALSERP data is a joint USAARL and USASC effort. USAARL operates in conjunction with the CAI team through the MOU with USASC (MOU, 1991). Our success in collecting, investigating, documenting, and reporting on ALSE is related directly to our ability to participate and interface with principal members of the CAI. USAARL participation is not limited to lab analysis. To the extent possible, the ALSERP team collects and analyzes equipment at the crash site. If the ALSERP team is unable to visit the crash site, written instructions are published in the Accident investigation handbook, Appendix GG (USASC, 1994) that define assessment criteria to aid the CAI in selecting artifacts that should be sent to USAARL for lab analysis (USAARL Policy 95-55, Appendix B, page 18, "Accident site assessment criteria").

A standard measure for injury classification increases the utility of our data to a wider population than just the U.S. Army. The abbreviated injury scale (AIS), published by American Association for Automotive Medicine, 1990 revision, is the foundation for cataloging ALSERP injury data. The ALSERP team utilizes the actual medical report or autopsy in addition to the DA Form 2397-9-R, "Technical report of Army accident report," to correlate injury and human tolerances to external forces.

The composition of the ALSERP inspection team is a critical element in validating the outcome of case deliberations (USAARL Policy 95-55, Appendix B). USAARL uses a team from the selected disciplines of ALSE, medicine, engineering, aviation, and safety. The ALSE technician is current and versed on the equipment being analyzed. The flight surgeon is active and on flight status representing the specific military service involved in the accident. The design engineer may be an aerospace or mechanical engineer with experience in the specific item being analyzed. The pilot is an instructor pilot currently on flight status and preferably qualified in the specific aircraft type, model, design, and series involved in the accident. The safety specialist performs the safety officer function as a primary duty and has experience in aircraft accident investigation and human factors engineering. Team members may perform dual functions such as an aviation safety officer who is also an instructor pilot, or an aerospace engineer who is also performing the duties of an ALSE technician. Epidemiological studies for the purpose of ALSERP are conducted by a USAARL epidemiologist who tracks USASC data. Additional expertise is drawn from the U.S. Armed Forces Institute of Pathology, the USASC and their field investigators, U.S. Army Natick Laboratories, program managers' offices for various aircraft and subsystems, etc., as necessary. No case review is accomplished without the presence of all necessary parties defined above. This participation by all parties ensures a thorough case study and eliminates questions at a later date. This procedure is not compromised. The team effort is managed by the ALSERP manager whose duties are defined in USAARL Policy No. 95-55 (Appendix B).

Equipment and procedures

Failure mode analysis is an important part of the ALSERP process. The lab's ability to duplicate component and subcomponent damage assists in determining cause and effect relationships and impact magnitudes. Lab assets available to conduct these tests include:

a. Tinius Olsen static test machine. Duplicates load capabilities of the helmet chinstrap and can measure failure data used to compare with Army specifications.

b. Inertia reel tester. Measures the amount of G-forces required to lock inertia reels and enables the lab to determine whether or not the equipment operates within design specifications.

c. Monorail drop tower. A gravity drop tower capable of duplicating helmet impact damage and measuring G-forces associated with given helmet damage.

d. Side angle drop tower. A drop tower capable of reproducing tangential impact damage to helmets consistent with flailing impact associated with rotary wing accidents.

e. MTS dynamic test machine. Allows the ALSERP team to dynamically test attenuators.

f. Pendulum drop tower. Measures the ability of the helmet to remain on the individual's head during the impact sequence and records the degree of rotation of the helmet on the neck.

g. Thickness gauge. Measures the amount of compression in the helmet liner.

h. Isotemp® oven. Allows investigators to heat ALSE items to extremely high temperatures for duplication purposes.

i. Sears Craftsman band saw/sander. Used to cut retrieved ALSE and gain access to areas with inspection importance.

j. Refrigerator. Used to store biologically contaminated items pending ALSERP investigation and disposition.

k. Dremel Moto tool. Used to cut and sand down items on retrieved helmets in order to gain access to components.

l. Jensen tool kit. A 69-piece tool set used to access all parts and components of ALSE.

m. Sewing machine, industrial. Gives the ability to repair torn stitching and duplicate impact forces for test and evaluation.

n. 35 mm camera. Allows the ALSERP team to record the inspection and analysis of equipment failure.

o. Caliper vernier. Measurement tool.

Discussion/Conclusions

The investigation and identification of cause factors in aviation accidents are only the first steps in providing what should be expected from a safety assessment. The presentation of clear injury data used to substantiate design improvements and the exploration of design alternative concepts should be the goal of a comprehensive program. The ALSERP strives to meet these goals throughout the ALSE spectrum. Cost benefit analysis provides the basis for crashworthiness improvements and have led to design firsts in crashworthy seating, aircraft/airframe crashworthiness, new requirements in head protection, human anthropometric design requirements for optimized performance and survivability, inertia reel and seat restraint system direction, and considerations for helmet design relating to stability required for helmet-mounted displays. Frangibility of aircraft structure and the associated mechanical insult are now included in the systems approach to cockpit design due to accurate substantiated health hazard identification. Regulatory authority to retrieve material, coupled with a tested process of data collection and the required membership of varied disciplines in the investigation, guarantee the overall success and validity of this program.

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Appendix A.

ALSERP successes

Since 1972, USAARL has received and assessed, over 350 flight helmets, 100 aircraft seats, numerous restraint systems, inertia reels, and other postaviation mishap items such as survival vests and articles of flight clothing. Assessment results led to further research, especially in helmet technology. Human head and neck response to impact acceleration and head injury pathology were studied with a focus on the helmet and its ability to protect the individual from flailing and impact injury. The ALSERP reports were published on helmet damage and head injury correlation, citing head injury at peak acceleration levels far below the 400 g used for the manufacturing performance criteria in Army helmets at that time. Subsequently, technology was challenged to move the drop height from 3 feet with a maximum allowable force to the headform of 400 g, to a drop height of 6 feet and a "never to exceed" headform peak acceleration of 150 g. These criteria are being met today. Two reports discussed the SPH-4 helmet performance. The first covered the period 1972-1983 (Reading et al., 1985) and the second reviewed the period 1983-1987 (Vyrnwy-Jones, Lanoue, and Pritts, 1988).

A report published in 1991 looked at helmet impact protection improvements that occurred from 1970-1990 reflecting continuous helmet reappraisals and design recommendations made by USAARL and the ALSERP (Palmer, 1991). These design recommendations, a direct result of accident experience, led to improved impact effectiveness of the aviation helmet. They include:

Helmet shell:

> The encouragement to use a lighter weight helmet shell technology. The SPH-4 is made of fiberglass cloth and weighs 3.4 lbs; the SPH-4B is made of Kevlar™ cloth and weighs 2.8 lbs; and the HGU-56/P is made of Spectra™ and graphite cloth and weighs 2.6 lbs.

Helmet liner:

> The identification of helmet energy attenuation liner inadequacies in the first generation SPH-4 helmet series. This led to an iterative approach to improve the capabilities of the liner to protect the bearer from impact forces. Initially the thickness of the foam was increased from 3/8 inch to 1/2 inch. Later, the SPH-4B helmet was fielded with a 6/10-inch thick foam liner while the density of the material was decreased. The recently fielded HGU-56/P has a 7/10-inch thick liner whose density was further decreased.

Helmet visor:

The documentation of a high helmet visor failure rate. This industry challenge resulted in the fielding of a shatter resistant polycarbonate visor. USAARL also articulated support for dual visors. The SPH-4B and the HGU-56/P were fielded with dual visors.

Helmet chinstrap:

The identification of inadequate chinstrap static strength and multiple failure points. USAARL research led to increasing the requirement from 150 to 300 lbs. minimum tinsel load. Currently the minimum load is 440 lbs. Chinstrap snap technology was also maximized by USAARL researchers but they deferred to double D-ring technology. USAARL is pursuing a quick release design chinstrap to improve egress capabilities.

Helmet retention system:

The identification of retention tab stitching/material failures. USAARL designed the yoke harness system used today.

Helmet nape strap:

The identification of problems adjusting and keeping the nape strap snug when the strap is one continuous piece of material. USAARL articulated the need for improved adjustment capability resulting in a two-piece Velcro® design that meets adjustment requirements.

USAARL entered the concept evaluation field in 1982 over the concern for transmitted loads to the head from lateral impacts in the helmet earcup area. Designed for sound attenuation, the standard SPH-4 earcup reached a compressive force of up to 5,000 lbs prior to fracture which was well beyond human tolerance. USAARL contracted for the manufacture of an energy attenuating (crushable) earcup that would also meet the acoustic protection requirements of the Army. The metal crushable earcup directed by USAARL proved satisfactory on both counts. Again, faced with proven versus accepted issue, the ALSERP "finished the job" by performing a study and publishing a report on lateral impact to the head (Shanahan and King, 1983). Another study (Shanahan, 1985) reviewed aircraft accident case files between 1971 and 1979, including 222 flight helmets, and found that lateral impacts clearly yielded a higher rate of serious injury to the head (AIS greater than 4) at a 68 versus 46 percent incidence. Similarly, there was a greater incidence of basilar skull fracture due to lateral impacts than to other areas of the helmet (46 versus 18 percent). This report also found basilar skull fracture to be the leading cause of fatality in helicopter accidents. These reports clearly established an increased incidence of basilar skull fracture as a byproduct of current technology and again offered the concept of an energy attenuating earcup from the survivability standpoint. Today, contractors successfully manufacture crushable earcups of plastic and polyvinyl chloride. Various types are now included in the SPH-4B and the new HGU-56/P helmets. Crushable earcups are one of the basic design requirements for all future Army aviation helmet systems.

In 1982, USAARL published Analysis of U.S. Army aviation mishap injury patterns that summarizes the U.S. Army process for gathering aviation injury data, and provides examples of use of the data resulting in fleet-wide improvement programs and recommendations (Hicks, Adams, and Shanahan, 1982).

The issue of energy attenuating earcups in aviation helmets again surfaced following an ALSERP mishap review. The U.S. Army Communications and Electronics Command (CECOM) developed earcups as a subcomponent of a secure voice communications system for rotary-wing aircraft (project name of TEMPEST). TEMPEST earcups were installed in attack and aeroscout pilots' helmets in the belief that they prevented electromagnetic interference. These earcups were not a noncrushable design and did not provide sufficient protection to prevent the incidence of basilar skull fracture. These earcups were installed in the recovered pilot's helmet. ALSERP research led to the recision of the TEMPEST earcup requirement. This is especially important since crushable earcups were removed to accommodate the TEMPEST earcup (Voisine, TM 95-5, Jan 96).

When helmet-mounted sight systems were added to Army aircraft, USAARL assessed the effect of vibration on the sight using mechanical linkages (Johnson, Priser, and Verona, 1981). In 1981, a variable weight center of gravity (c.g.) helmet simulator was developed for assessing helmet-mounted devices and their effect on muscle loading and fatigue on aviation crewmembers (Svoboda and Warrick, 1981). The results of these studies established criteria for the development of helmet sight technologies currently being considered for the RAH-66 Comanche.

Scientists and engineers from USAARL and the ALSERP participated in the design and fielding of the AH-64 Apache helicopter. The integrated helmet and display sighting system (IHADSS) was developed by the manufacturer with limited input from the Army other than basic global design requirements and goals. Early in the development, the contractor was using a poured foam-type liner which USAARL identified as a component that failed to meet impact standards. The use of this liner continued throughout development because of its superior stability attributes. Stability was a recognized critical factor in helmet-mounted sighting issues. USAARL engineers, often perceived as a thorn in the side throughout the development process, successfully argued helmet survivability issues. This resulted in the contractor developing a helmet that met both stability and impact test requirements.

USAARL became the first IHADSS helmet fitters. The ALSERP laboratory was the initial fitting station for AH-64 transition course pilots and also became the contact point for helmet materiel problems relating to the IHADSS. USAARL fitted two sessions of pilot classes once a week and noted continuous problems fitting this population with the size regular or large IHADSS. Research found that the helmet had been manufactured to specification. USAARL then assessed the pilot population and found that the 1970 anthropometric data used for the specification did not reflect the pilot population entering the AH-64 training program. USAARL then funded a world-wide survey of all attack pilots in the Army and found that the head anthropometry of these pilots was close to a full centimeter larger in the 99th percentiles of the 1970 data identified in the specification. Further, the M-43 protective mask was designated as the protective mask of the Apache program and it had to fit the pilot's head under the helmet which added a new delta to the head dimensions. The study showed that 9.6 percent of the population would have difficulty fitting the IHADSS alone, and 29.5 percent of the pilot population would have difficulty fitting into the IHADSS while wearing the M-43 protective mask (Rash and Martin, 1987). USAARL completed the research and provided the criteria for the extra large IHADSS helmet currently in service.

Participation in the AH-64 program continues through the ALSERP. A fatal mishap revealed a possible design flaw in an overhead circuit breaker panel. Although not a contributing factor in the fatality, the undesirable frangibility of this overhead panel was noted as a failure by the ALSERP investigators at the accident site for the third time in three AH-64 aviation accidents. The possibility of this panel causing injury was clearly present. The ALSERP personnel forwarded information on this hazard to the program manager's office who included this issue in the next system safety working group. The resulting manufacturer investigation led to redesign of the connection points for the overhead panel. This is not an ALSERP issue, but it was explored because of possible interface with the helmet worn by the crewmember and the potential for mechanical insult during mishaps.

USAARL's concern went beyond the aviation crewmember protective helmet when bump protection requirements of the armored vehicle crewman's helmet were studied. Injury patterns were evaluated and guidance was provided to the U.S. Army Airborne School, the 18th Airborne Corps, and Natick Laboratories relating to head injuries and protective alternatives for airborne training and operations.

In response to back injuries suffered by OH-58 pilots involved in aviation mishaps, USAARL designed, validated and flight tested a retrofit crashworthy seat . This seat concept was adopted by Bell helicopter and is designed into the TH-67 Army training helicopter. A retrofit program for the OH-58D Kiowa Warrior will also include the crashworthy seat.

Inertia reels and restraint systems are a primary area of interest in the ALSERP. Army experience with accidents involving head and face strikes on optical tracking devices in attack helicopters, due to seat belt elongation, resulted in a material change from nylon to Dacron. This mitigated the problem but did not solve the issue. When shoulder harness lead-in strap failures occurred in one particular aircraft type, timely ALSERP participation identified incorrect installation of the seat belt guide as the cause (Hundley, 1984). The corrective action was an immediate grounding of all aircraft and a onetime inspection for, and correction of, this deficiency. ALSERP research also supported the development and fielding of the 5-point restraint system in new aircraft to prevent injuries due to submarining. A study of U.S. Army helicopter inertia reel locking failures led to USAARL's participation in specification development and flight testing of a vehicular sensitive inertia reel (McEntire, 1992) . The MA-16 is currently being fielded.

The USAARL ALSERP has led the NATO community in accident investigation techniques concerning optimized evaluation of aviation mishaps and the relationships between the mishap, aircraft, the life support equipment involved, and the aviation crewmembers. The USAARL ALSERP is the basis for several new NATO programs (Licina and Sippo, 1992).

ALSERP research of U.S. Army aircraft accidents showed injuries of pilots due to striking a structure inside the cockpit outnumbered those due to excessive accelerations by a 5:1 ratio. Sled tests at 7 and 25 g indicated that airbags reduced head accelerations by 65 percent, head injury criteria by 77 percent, and head angular acceleration by 76 percent (Alem, et al. 1991). These results led to airbag development programs for the UH-60 and OH-58, and are an integral part of the RAH-66 Comanche helicopter program.

U.S. Army aviation's latest effort is the development of the RAH-66 Comanche helicopter. Unlike the Apache program, USAARL's participation in the statement of work (SOW), setting of program requirements, and source selection board not only was actively sought, but has been and continues to be funded by the Comanche Program Manager. USAARL provided criteria in the form of a report defining health hazard issues in the helmet integrated display and sight system (HIDSS) for the Light Helicopter Experimental (LHX) (Barson, et al., 1988). This report was used by the competing teams in the conceptual development of their respective candidate helmet technologies. Innovative approaches to headborne visionics and head protection were explored and presented by the competitors. USAARL responded by considering these new approaches and modified the Army's' requirements to address and allow exploration and development of these new concepts and devices. As of March 1996, major issues of concern in the helmet arena for this program remain the visionics, crashworthiness, mass properties, acoustics, helmet retention, and protective visors. USAARL and ALSERP team members currently are full members of the crew station, helmet, airframe, MANPRINT, and system safety working groups of the program.

In summary, the investigation and identification of cause factors in aviation accidents are only the first steps in providing what should be expected from a safety assessment. The presentation of clear injury data used to substantiate design improvements and the exploration of design alternative concepts should be the goal of a comprehensive program. The ALSERP strives to meet these goals throughout the ALSE spectrum. Cost benefit analysis provides the basis for crashworthiness improvements and have led to design firsts in crashworthy seating, aircraft/airframe crashworthiness, new requirements in head protection, human anthropometric design requirements for optimized performance and survivability, inertia reel and seat restraint system direction, and considerations for helmet design relating to stability required for helmet-mounted displays. Frangibility of aircraft structure and the associated mechanical insult are now included in the systems approach to cockpit design due to accurate substantiated health hazard identification. Regulatory authority to retrieve material, coupled with a tested process of data collection and the required membership of varied disciplines in the investigation, guarantee the overall success and validity of this program. Continuing unsolicited requests for assistance by the program office responsible for the development of the next generation of U.S. Army helicopter, the RAH-66 Comanche, illustrates the maturity and the utility of this program to the target audience, U.S. Army aviation.

Appendix B.

USAARL Policy No. 95-55. ALSERP operating procedures.

HEADQUARTERS
U.S. ARMY AEROMEDICAL RESEARCH LABORATORY
Fort Rucker, Alabama 36362

USAARL POLICY
NO. 95-55

3 February 1995

Aviation Life Support Equipment Retrieval Program

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Aviation

Aviation Life Support Equipment Retrieval Program

1. References:

a. AR 95-1, Aviation Flight Regulations, dated 30 May 1990.

b. AR 340-17, Safeguarding for Official Use Only (FOUO) Information, dated 1 October 1982.

c. DA Pamphlet 385-40, Army Accident Investigation and Reporting, dated 1 November 1994.

d. Memorandum of Understanding (MOU) between the U.S. Army Safety Center (USASC) and the U.S. Army Aeromedical Research Laboratory (USAARL), signed 27 September 1991.

2. Purpose: This USAARL Policy delineates instructions, procedures and responsibilities and directs the operation of the USAARL Aviation Life Support Equipment Retrieval Program (ALSERP).

3. Scope: The provisions of this policy apply to all military and civilian personnel assigned to the ALSERP, Aircrew Protection Division, and to all other USAARL personnel who serve in the capacity of consultant to the ALSERP.

4. General:

a. Basic authority for the ALSERP is contained in DA Pamphlet 385-40, Army Accident Investigation and Reporting, paragraph 2-4h.

b. The goal of the ALSERP is to maintain and increase the level of aircrew protection during aircraft mishaps by the systematic analysis of occupant injury, material damage, and equipment performance.

c. The objective of the ALSERP is to determine why impact injuries were or were not received, and to develop concepts and criteria for design improvements through the analysis of injuries and retrieved life support equipment for the mitigation and reduction of crash-induced injuries.

d. Aircraft mishaps provide a unique source of information about human exposure and tolerances to external forces. The study of these events should result in a better understanding of human biodynamic reactions and tolerances to the forces. The increased understanding will provide improved life support equipment design requirements.

5. Definitions:

a. Aviation Life Support Equipment (ALSE) is equipment designed to sustain aircrew members and passengers throughout the flight environment, optimizing their mission effectiveness, providing protection mechanisms, affording a means of safe and reliable escape, survival, and recovery in emergency situations.

b. The Aviation Life Support System (ALSS) consists of components, techniques and training required to ensure aircrews and their passengers the best possible flight environment. Beyond providing for maximum functional capability of flying personnel throughout all environments experienced during normal missions, the ALSS also affords the means to enhance safe and reliable descent, escape, survival, and recovery in combat and emergency situations. These capabilities are achieved by the integration of three subsystems, each composed of functionally related components which comprise the ALSS. This integration effort is to ensure maximum combat mission effectiveness of the total system by enhancing crewmember performance potential. The ALSS is described in detail in Appendix A.

c. ALSERP Team. ALSERP team membership is defined in Appendix B. Team members possess interdisciplinary skills, experience and training necessary to evaluate retrieved ALSE equipment for the purpose explained in paragraph 4.

6. Submission of Aviation Life Support Equipment for Laboratory Analysis:

a. IAW DA Pam 385-40, paragraph 2-4h, all aviation life support and personal equipment which is in any way implicated in the cause or prevention of injury will be sent to USAARL for analysis. The purpose of this analysis is to evaluate the effectiveness of protective equipment in the aircraft mishap environment and effect equipment improvements through modification or development of existing and new design criteria. This equipment includes, but is not limited to, helmets, flight clothing, boots, survival equipment, first aid kits, seats, restraint systems, parachutes, and oxygen equipment.

b. When a mishap occurs and an ALSERP representative is not present, the President of the Accident Investigation Board, the safety officer, or unit ALSE officer will arrange for shipment of the ALSE involved to the Commander, ATTN: MCMR-UAD-CI (ALSERP), USAARL, Building 6901, P.O. Box 620577, Fort Rucker, AL 36362-0577.

(1) Equipment items sent to USAARL will be noted on item 7, DA Form 2397-10R (Technical Report of US Army Aircraft Accident, Personal Protective/ Escape/Survival/ Rescue Data). A copy of the ALSERP equipment turn-in inventory will accompany items mailed to USAARL (see Appendix C).

(2) Unit accountability will be IAW AR 735-11. Equipment will be itemized on DD Form 200 (Report of Survey) or DA Form 444 (Inventory Adjustment Report). USAARL will send a letter of receipt to the originating unit within 5 days of delivery.

(3) Upon completion of laboratory analysis, USAARL will dispose of unserviceable items and return serviceable items to the owning individual or unit. Biologically or chemically contaminated items are considered unserviceable and will be disposed of IAW AR 200-1 and USAARL Hazardous Waste Policy.

7. Operating Procedures:

a. Accident Investigation. When feasible, an ALSERP representative will accompany the USASC Centralized Accident Investigation (CAI) team on selected Class A and B flight mishaps.

b. Accident Notification. The USASC will electronically notify the USAARL ALSERP manager of all aviation accidents and incidents. A minimum of three ALSERP team members will meet to determine whether or not to participate first hand in the investigation or allow the CAI team to gather data for them. Should USAARL elect not to participate, accident investigators have instructions that define criteria for gathering, photographing, and shipping the equipment to USAARL (Appendix C).

c. Accident Launch Criteria. USAARL will actively participate to the extent possible in the investigation of selected A and B mishaps jointly with the CAI providing expertise, information, and historical data of ALSE. The following guidelines will be used to determine ALSERP participation in any CAI mishap investigation:

(1) The mishap must be classified as Class A or B.

(2) The aircraft involved is a U.S. Army aircraft (or as requested by other services within DOD).

(3) At least one crewmember survived the mishap, or if any ALSE prevented or failed to prevent injuries.

(4) The wreckage is accessible for investigation and analysis.

If the ALSERP Team determines that participation is warranted, arrangements will be made to transport the ALSERP investigator to the accident site by whichever means is most cost effective and timely (Military Air, Commercial Air, etc.).

d. Crash Site Actions. Responsibilities of USAARL team members participating with the CAI are as follows:

(1) Assist USASC investigators determine aircraft crash kinematics.

(2) Assess the performance of ALSE, crashworthy seats and restraint systems.

(3) Assess the survivability of the aircraft environment: cockpit for the pilot and copilot, and applicable crew stations for crewmembers and additional passengers.

(4) Correlate the human to the equipment response.

(5) Determine injury mechanisms for major/significant documented injury.

(6) Assist the CAI team as requested, per the MOU.

e. All ALSERP equipment received at USAARL will be directed immediately to the ALSERP lab. ALSERP team members will be notified and the container will be opened in accordance with the ALSERP Bloodborne Pathogen Program (Appendix D). The equipment is then assigned a USAARL Case Number (if one was not assigned when notified of the accident), and logged in the ALSERP master file. At this point, each piece of equipment will be tagged and marked so that the following information can be immediately obtained and no loss of equipment occurs:

(1) USAARL case number.

(2) USASC case number.

(3) Accident date.

(4) Aircraft type.

(5) Received by.

(6) Crewmember's last name.

(7) SSAN.

(8) Crew position.

(9) Date received.

All individual parts, pieces and components separated from the basic piece of equipment will be tagged and identified per above and stored in a container to preclude loss of component integrity.

f. The case folder, identified by the USAARL Case Number, will be prepared and maintained by the ALSERP manager. All notes, calculations, photographs, memos, and other material related to the case will be maintained in this file. Each item (photo, etc.) will be individually marked with the complete information provided in para 7e above. Each entry will be dated and signed. The file will include selected DA Forms 2387 obtained from the U.S. Army Safety Center. Each file will be considered an annex to the ALSERP lab notebook, and will receive storage protection and treatment appropriate for all FOR OFFICIAL USE ONLY (FOUO) documentation. FOUO documents must have custodial responsibility at all times and must be stored under lock and key when not being used. It is not sufficient to place case files inside individual desks at the close of business. These files will only be made available to ALSERP team members. Accountability will be maintained.

g. Whenever a case file leaves the security container it will have an FOUO cover sheet attached and will be handled as such. Any case file left unattended will be considered a security violation. All case files will be secured by the ALSERP manager in the ALSERP lab.

8. Equipment Evaluation:

a. General.

(1) A concise but detailed narrative describing the inspection of each piece of equipment will be transcribed on the appropriate ALSE Review Form (Appendix E) and placed in the case file.

(2) To assist in the ALSE evaluation, Appendix F lists references to be utilized in the evaluation and inspection of specific equipment. A memorandum should be prepared describing the external appearance, the description of gross condition of major components, and detailed description of visible damage or failure. Evidence of any authorized or unauthorized modification to equipment will be described in detail.

(3) All equipment is to be evaluated by the ALSERP team whose membership is outlined in Appendix B.

b. Photography Procedures:

(1) The CAI team is asked to provide multiple photographs of the occupiable space of the mishap aircraft from different angles and directions. These photographs will be cataloged upon receipt IAW paragraph 8b(4) below.

(2) Each piece of equipment received will be photographed, as necessary, by the ALSERP team.

(3) Garments will be photographed on a manikin, when possible, providing a more realistic reference.

(4) Each photograph will have a standard legend card with metric and English rule affixed. Legend will include USAARL Case Number, item photographed, date, and position orientation of the photograph. As a minimum, the following views of each item will be taken: anterior, posterior, and lateral. Special areas of interest will be identified by use of a standardized arrow. During disassembly, components which failed or contributed to injury will be photographed. Highly magnified photographs will be taken of all failed parts in multiple views, if necessary. The number of prints of each view will be determined by the ALSERP team. Proof sheets will be developed and entered into the file folder.

c. Examination of Helmets:

(1) Following inspection and initial photography, examination will proceed in accordance with sound engineering practices.

(2) The shell and compressible liner will be examined to determine if compression or damage has occurred. The amount of compression and/or damage, type of damage, and size and location of the damaged area will be measured and recorded.

(3) Attachments to the helmet such as ANVIS, HDV, HSS, PVS-S, CBR MASK etc., will be evaluated to determine whether or not they contributed to injury.

(4) The retention system will be evaluated for :

(a) Evidence of stress.

(b) Failures of straps, clips, screws, "pull the dot" fasteners, buckles, grommets, or rivets.

(c) Evidence of stretching, wear, or fraying.

(d) Adequate chinstrap security/adjustment.

(e) Adequate nape strap security/adjustment.

Notation will be made on helmet rotation on DA Form 2397-10.

(5) The suspension fitting system will be examined and described per helmet type.

(6) The communication system, earphones, and microphone will be examined for:

(a) Condition of all attachments.

(b) Condition of the microphone boom.

(c) Evidence of impact.

(7) The earcup will be evaluated for compression, evidence of cracks, and condition of the plastic earpad.

(8) The visor is examined for:

(a) Any deviation from the normal.

(b) Determination of visor's position (up or down).

(c) Evidence of impact.

(9) The findings of the evaluation will be summarized as concisely as possible. Failure modes will be summarized and related to the findings. The mechanisms of injury or injury prevention will be included. When a cause and effect relationship can not be established, an appropriate statement will be included.

d. Flight clothing.

(1) All flight clothing will be examined. Tears, gouges, rips, burns, deformities, and preexisting state of wear and tear will be annotated in the respective case file for all flight suits, gloves, boots, and undergarments, if applicable.

(2) Photographs will be taken IAW paragraph 8 of this policy.

(3) Fuel and other odors and stains should be noted.

(4) Presence of starch in the garment also should be annotated.

(5) Types and weave of fabrics will be identified. All manufacturing and contract/lot number information will be recorded.

(6) Clothing exposed to fire will be evaluated to the extent possible. Precise description of burned, fused, stiff, brittle, discolored, or charred areas will be recorded to include lacerations and dimensions. Shrinkage areas will be described.

(7) An effort will be made in the case of the Aviation Battle Dress Uniform (ABDU) to determine if the shirt was worn in or out and if the trousers were bloused or not, as well as the blousing mechanism.

(8) Mechanisms of injury, amount of exposure, and degree of protection will be

estimated.

(9) Other items of ALSE such as the survival vest and the condition of each subcomponent will be evaluated in the same manner, using the same criteria for the garments.

9. Seats, Restraint Systems, and Inertia Reels.

a. Crashworthy seats will be evaluated for proper function and evidence of distortion, corrosion, or damage inconsistent with a properly stroking seat. Photographs will be taken IAW paragraph 8b.

b. An effort will be made to determine if seats stroked or if obstructions prevented the seat from stroking. Seat crash attenuation mechanisms will be measured to record the length of the stroke.

c. Restraint systems will be evaluated for failures of the webbing and adjustment buckles.

d. Inertia reels that have not performed in accordance with design specifications will be inspected and tested to determine lock settings. Tear down analysis may be performed on inertia reels which do not meet specifications.

10. Excessively Damaged or Destroyed ALSE.

a. Itemization and detailed examination of retrieved ALSE should not be performed until the appropriate DA Form 2397 series are received from USASC.

b. If retrieved ALSE is determined to be excessively damaged, making the information obtained of minimal value (i.e., equipment retrieved from a catastrophic nonsurvivable accident with postcrash fire, or it burned on impact), the ALSERP team may elect to dispose of the equipment without further investigation. Photos will be taken for the record. Entries will be made in the case file on disposition of each item of equipment received.

c. Storage of ALSERP retrieved equipment for historical documentation will be determined by the ALSERP team. All nonserviceable equipment not maintained will be incinerated IAW AR 200-1 and the USAARL Hazardous Waste Policy. The case file will be annotated with the date, item, and individual responsible for the disposal.

d. Items deemed serviceable will be returned to the owning person or unit.

11. Reports on ALSE to the CAI. Upon request from the USASC, the ALSERP team will investigate and report on those items deemed important by the CAI. This report will be sent to USASC for inclusion in the official accident report.

12. The ALSERP Data Base. Once the evaluation is complete all the data in the case file will be transferred to the ALSERP data base. Access to the ALSERP data base is limited to the ALSERP team members only.

The proponent office of this policy is the Aircrew Protection Division, USAARL. Users are invited to send written comments and suggested improvements to that office.

DENNIS F. SHANAHAN
COL, MC, MSF
Commanding

6 Encl
1. Appendix A - Aviation Life Support System Description
2. Appendix B - ALSERP Council
3. Appendix C - Accident Site Assessment Criteria
4. Appendix D - ALSERP Bloodborne Pathogen Program
5. Appendix E - ALSE Review Forms
6. Appendix F - ALSERP References

DISTRIBUTION:
Policy Statement File
HQ, USAARL
Each Division

Appendix A.

Aviation Life Support System Description

1. The Aviation Life Support System (ALSS) is necessary to assure the aircrewmember becomes a part of his weapon system, remains functional in its environment, sustains him in an emergency or survival situation, and is responsive to his needs throughout the entire spectrum of aerospace operations.

2. System Description.

a. The ALSS consists of components, techniques, and training required to ensure aircrews and their passengers the best possible flight environment. Beyond providing the maximum functional capability of flying personnel throughout all environments during normal missions, the ALSS also affords the means to enhance safe and reliable escape, descent, survival, and recovery in combat and emergency situations. These capabilities are achieved by the integration of three subsystems, each composed of functionally related components, which comprise the ALSS. The integration effort is to ensure maximum combat mission effectiveness of the total weapon system by enhancing the performance potential of the crewmember.

b. The ALSS is composed of the following three subsystems:

(1) Environmental life support subsystem. This subsystem provides optimum support, protection, and comfort to flying personnel and their passengers in all normal flight environments. Maximum mission effectiveness is enhanced by superior aircrew station and personal equipment such as oxygen equipment, aircrew support facilities, flight and specialized clothing, and miscellaneous personal accessories and equipment. Environmental support equipment includes but is not limited to:

(a) Flight clothing, gloves, helmets, fire retardant flight suits and chemical and biological (CB) suits, and boots.

(b) Aircrew body armor as an ensemble.

(c) Environmental control items (pressure, temperature and humidity gauges).

(d) Warning devices (hypoxia, chemical biological and radiological alarms).

(e) Oxygen systems (all inflight and walk around equipment, regulators, bottles, hoses and connectors).

(f) Protective masks (oxygen, CB and smoke).

(g) Eye protective devices (laser, nuclear flash, visors and sunglasses).

(h) Support equipment (flashlights, pilot clipboards, microphones and headsets, fire extinguishers and first aid kits).

(i) Restraint devices (seat and lap belts, shoulder harnesses, five-point restraint systems, torso harnesses, and inflatable leg, head and head restraints).

(2) Escape and descent life support subsystem. The escape and descent life support subsystem components are provided to ensure safe and reliable escape and descent from disabled aircraft. Presently included are harnesses, parachutes, ejection crashworthy seats, propellent devices, and let down ropes and equipment. Also included are devices to improve capabilities for passenger escape either onto the ground or into the water through explosively created exits or escape slides. Equipment includes but is not limited to the following:

(a) Forced escape devices (ejection seats, extraction devices, crew escape systems, rocket catapults, seat stabilizers, and propellent actuated devices).

(b) Crashworthy devices (fuel cells, energy attenuation seats, and troop seats).

(c) Seat cushions and lumbar supports.

(d) Nonflammable materials.

(e) Controlled descent devices (ground evacuation slides, troop and aircrew ladders, crash rescue seats and axes).

(3) Life support survival recovery subsystem. The life support survival recovery subsystem aids survival, evasion, escape, and recovery of downed aircrews and their passengers in any global environment. Components include life preservers and rafts, anti-exposure suits, aircrew CB and environmental clothing, and survival vests and kits. Signaling devices such as lights, flares, beacons, survival radios, personal locating devices, and power sources also are included to locate personnel. Equipment includes:

(a) Environmental clothing (cold weather clothing, wet suits, and anti-exposure suits).

(b) Distress incident locators (electronic transmitters, personal locator systems, rescue beacons, visual and audible signal devices, and search and rescue radios).

(c) Rescue equipment (hoists and rescue harnesses).

(d) Survival equipment (survival kits, vests, and weapons, food packets, first aid kits, sleeping bags, life preservers, and rafts).

(e) Signal devices (flares, strobe lights, and ground signaling panels).

Appendix B.

Aviation Life Support Equipment Retrieval Program (ALSERP) Team

1. The interdisciplinary ALSERP Team will meet, as required, to evaluate retrieved aviation life support equipment (ALSE) to determine if the artifacts caused, contributed to, failed to prevent, or prevented injury to its user, and also to determine if there is a need for transmittal of information to U.S. Government agencies involved in the Aviation Life Support System (ALSS). Testing and disposition of equipment will be addressed. The team will determine to what extent the findings are to be reported and assign specific individual taskings to be completed.

2. Membership:

a. Aerospace/Mechanical Engineer

b. ALSE Specialist/Primary Investigator/Human Factors Engineer

c. Flight Surgeon

d. Biological Science Assistants (as necessary)

e. Aviation Safety Officer / Aviator / Instructor Pilot for the specific aircraft (as necessary)

f. ALSERP Manager

g. Epidemiologist

3. A minimum of three members must be present to constitute a quorum.

4. Coordinating the ALSERP team effort is the responsibility of the ALSERP manager. Specific responsibilities include:

a. Maintaining a close working relationship with the USASC.

b. Reviewing electronic mail messages daily to ensure timely receipt of mishap information.

c. Gathering the team to appraise them of known class A and B mishaps and to determine the extent of USAARL's participation.

d. Coordinating with the CAI team to ensure ALSE is delivered to USAARL in a timely manner.

e. Assembling the ALSERP team to analyze the mishap artifacts and providing reports to the CAI as soon as possible following analysis.

f. Disposing of unserviceable and contaminated equipment and returning serviceable items to the owner as soon as possible after analysis of the mishap is complete.

g. Ensuring the ALSERP data base is maintained.

h. Reviewing and revising the USAARL/USASC MOU periodically.

Appendix C.

Accident Site Assessment Criteria

SUBJECT: Aviation Life Support Equipment Retrieval Program (ALSERP) Crash Site Assessment Criteria

1. The U.S. Army Aeromedical Research Laboratory's (USAARL) ALSERP mission is to collect, analyze and report on the performance of aviation life support equipment (ALSE) involved in aviation mishaps. We determine why occupant injuries were or were not received and how those injuries may be prevented or reduced in severity. Our objective is to determine if design was adequate, if the equipment was manufactured to design specifications, and if the item was worn properly.

2. DA PAM 385-40, the governing regulation for our program, states that "all life support and personal equipment which is in any way implicated in the cause or prevention of injury be shipped to USAARL." Paragraph 2-4h places the burden in the determination of whether or not an item should be shipped on the accident investigator. In order to assist investigators in this task, the following accident site assessment criteria should be used to determine if the equipment is to be forwarded to USAARL.

a. The lab does not desire ALSE retrieval if the mishap was determined to be non-survivable **and** there were no survivors.

b. Helmets:

(1) Any visible damage, either external or internal, that was the result of the mishap.

(2) Any head injuries (even if helmet is undamaged).

(3) If rotation or dislocation is suspected.

(4) Helmet or visor show signs of impact (with cyclic or TSU or ORT).

c. Life support equipment (LSE) or personal belongings:

(1) Any LSE's failure to provide protection as designed. Of particular importance is the performance of recently fielded items of ALSE such as the ABDU and SARVIP.

(2) Any LSE that contributed to or caused injury (threadbare uniforms, stitching failures, nylon undergarments, unauthorized LSE such as Hi-Tech boots, personal items that cause injury such as sheath knives, etc.).

(3) Any LSE that restricted or hindered egress.

(4) All LSE associated with postcrash fires.

d. Restraint systems and inertia reels.

(1) All failures of the belt, harness, buckle or inertia reel.

(2) When upper torso and flail injuries are present.

(3) All unserviceable items of personal restraint.

e. Seats (crashworthy):

(1) Seats will be shipped separately from other LSE and only after coordination with ALSERP personnel at DSN 558-6895/6893/6804 or COM (334) 255-6895/6893/6804. This is requested due to long delays in the packaging and shipping of seats.

(2) Stroked seat or if there is evidence that obstruction prevented the seat from stroking.

(3) When, in the experience of the investigator, the seat should have stroked but failed to do so.

(4) Evidence of distortion, damage or corrosion.

(5) Any spinal injury.

f. Photographs (injury correlation):

(1) Photographs are essential to ensure a comprehensive analysis of the mishap and to form a basis for comparison with similar accidents. Therefore, multiple photographs of the

occupiable space from different angles are requested.

(2) All seats.

(3) Main wheel assemblies (where stroking is evident).

(4) Struts for evidence of stroking.

(5) LSE that performed as designed (visor that impacted cyclic and prevented injury).

(6) When the roof of the aircraft collapses.

(7) When the floor under the crew stations experience distortion or crushing.

(8) Injuries when possible (to correlate injury).

3. If the investigation team desires a lab analysis of the equipment to be included in their report, ALSERP will respond within 1 week. This is contingent upon receipt of the following data, in draft form, along with the equipment.

a. Physician's statement of injuries.

b. Photo of injuries.

c. Autopsy, if applicable, with photos.

d. Description of mishap (-6 draft) including only the portions just prior to impact and the kinematics and dynamics of the accident.

4. The accident investigation team should contact USAARL at DSN 558-6895/6893 or COM (334) 255-6895/6893 if any questions arise regarding the identification and shipment of mishap LSE.

5. Enclosure 1 is an equipment turn-in inventory sheet that should be completed by the investigation team and accompany the turn-in items. It is imperative that the appropriate piece of ALSE be identified with the correct individual. Equipment items sent to USAARL will also be noted on item 7, DA Form 2397-10R (Technical Report of US Army Aircraft Accident). The turn-in inventory sheet does not constitute accountability. IAW AR 735-11, unit accountability

will be maintained by itemizing the equipment on DD Form 200 (Report of Survey) or DA Form 444 (Inventory Adjustment Report).

6. USAARL will send a letter of receipt to the originating unit within 5 days of delivery. Upon completion of laboratory analysis, USAARL will dispose of unserviceable items and return serviceable items to the owning unit.

ALSERP
Equipment Turn-In Inventory

ITEM	PILOT	COPILOT	CE	FE	PAX#1	PAX#2	PAX#3
NAME							
HELMET							
GLOVES							
VEST							
FLIGHT SUIT							
BOOTS							
RESTRAINT SYSTEMS							
INERTIA REEL							
BODY ARMOR							
LIFE PRESERVER							
A/C SEATS							
OTHER							
OXYGEN EQUIPMENT							
PARACHUTE							

The above listed items have been mailed to the U.S. Army Aeromedical Research Laboratory, ATTN: MCMR-UAD-CI (ALSERP), USAARL, Building 6901, P.O. Box 620577 Fort Rucker, AL 36362-0577, for postcrash aeromedical review and disposition. **All items are tagged with the name and position of the individual they relate to**.

Items of apparel are considered biologically hazardous, therefore, they must be sealed in suitable containers (orange BIOHAZARD plastic bag or, as a minimum, a trash can liner) and labeled with appropriate BIOHAZARD warnings.

Serviceable items will be returned to the owning organization or individual as soon as possible. Unserviceable items will either be destroyed or maintained by the USAARL for research purposes. Paperwork indicating the articles' disposition also will be sent to the organization.

A copy of this document will be placed in the container along with the equipment.

UNIT SAFETY OFFICER ______________ PHONE #________________
UNIT ALSE OFFICER/NCO ______________ PHONE #________________

Appendix D.

Aviation Life Support Equipment Retrieval Program (ALSERP)
Bloodborne Pathogen Program

1. PURPOSE. This program establishes the means to protect ALSERP investigators from bloodborne pathogens which might be encountered during the course of their investigations at the accident site and during examination of retrieved ALSE in the lab.

2. SCOPE. All personnel who participate in ALSERP accident site evaluation, ALSE retrieval and laboratory analysis are covered by this policy and must comply with these procedures in order to minimize their risk of exposure to bloodborne pathogens.

3. DEFINITIONS.

a. Bloodborne pathogens. Microorganisms present in human blood that can cause disease in humans. These include but are not limited to Hepatitis B virus (HBV) and human immunodeficiency virus (HIV).

b. Contaminated. The presence of or the reasonably anticipated presence of blood or other potentially infectious materials on an item or surface.

c. Occupational exposure. Reasonably anticipated skin, eye, mucus membrane or parenteral (below skin) contact with blood or other potentially infectious materials that result from the performance of duties.

d. Exposure incident. A specific eye, mouth, mucus membrane, non-intact skin or parenteral contact with blood or other potentially infectious materials that result from the performance of duties.

e. Hazardous waste. Liquid or semi-liquid blood, items that could release blood if compressed, items caked with blood and pathological and microbiological waste containing blood are all considered hazardous and as such, will be contained IAW this appendix and disposed of in accordance with USAARL hazardous waste procedures and IAW AR 200-1 and this appendix.

4. EXPOSURE CONTROL PLAN. This exposure control plan is a living document. It will be updated at least annually or whenever tasks or procedures change.

a. Exposure determination list. The following list identifies specific organizational staff positions whose incumbent may have occupational exposure to potentially infectious materials during the conduct of ALSERP investigations.

(1) ALSERP manager

(2) ALSERP noncommissioned officer

(3) Lab Safety and Occupational Health Specialist

(4) Engineer

(5) Epidemiologist

(6) Flight surgeon

(7) Instructor pilot

(8) Director, Aircrew Protection Division

b. Communicating hazards. Individuals assigned to these positions will receive information and training upon initial assignment and annually thereafter. Personnel assigned when this appendix was written will be trained within 30 calendar days of its effective date. Training will be conducted and documented IAW paragraph 8 of this appendix.

c. Prevention measures. Individuals occupying these position will be offered the Hepatitis B vaccination series on a no cost basis. Those who decline the HBV vaccination must do so in writing. A copy will be placed in their records IAW paragraph 9 of this appendix.

d. Methods of compliance.

(1) Universal precautions must be observed. All human blood, tissue, and specified or unspecified body fluids are considered to be infectious for HIV, HBV or other bloodborne pathogens.

(2) Engineering controls. Engineering controls reduce exposure by either removing or isolating the hazard or the worker. Antiseptic towelettes, contained in the ALSERP accident kit,

are used when hand washing facilities are not readily available. Infectious or contaminated materials will be kept in leak proof containers labeled with a biohazard label. Items being shipped will contain the biohazard label on the outside of the container. Equipment contaminated as a result of the field inspection including gloves and soiled clothing will be doffed and kept in a red biohazard plastic bag to prevent leakage during handling, transportation, storage and disposal.

(3) Work practice controls. The following work practice controls when effectively used will reduce the likelihood of exposure to biologically hazardous material. All accident sites where injury occurred are considered biohazard contaminated areas. Life support equipment received in the lab is also considered contaminated and will be handled in accordance with the following:

(a) Surgical gloves will be donned prior to opening any package and handling the contents of any package received for ALSERP purposes.

(b) Hand washing is required. Workers will wash their hands and any other skin with antiseptic soap and water or flush mucus membranes with water immediately or as soon as feasible following direct contact with blood, body fluids, or other potentially infectious materials. The sink on the hallway side of the lab has soap available and will be utilized for this purpose. At the accident site, team members will utilize antiseptic towelettes followed by a thorough washing as soon as facilities are available.

(c) Metal and sharp fibers contaminated with human blood at the accident site are of particular concern. Do not move, bend or twist sharp objects to preclude injury and exposure. Sharp fabrics should be moved slowly to prevent accidental injury and to reduce hazardous dust to a minimum. Be cautious of slipping and falling.

(d) Team members are prohibited from drinking, eating, smoking, handling contact lenses, applying cosmetics or lip balm, and doing any actions where a mucus membrane may be touched. Should an individual be required to leave the investigation area for personal needs the team member shall.

(1) Remove all personal protective equipment leaving non disposable equipment in the contaminated area..

(2) Place disposable protective equipment in a biohazard bag.

(3) Cleanse hands and face with antiseptic wipes and wash hands and face with soap and water as soon as possible.

(4) Storage of food and drink in the contaminated area is prohibited. This includes inside refrigerators, shelves, cabinets, storage compartments, etc.

(5) Nondisposable equipment that is contaminated will be disinfected after each use. If the items are to be transported prior to decontamination, they will be placed in biohazard containers.

(6) Lab work areas such as counter tops and sinks will be cleaned and disinfected when an investigation is complete. All spills will be picked up and placed in biohazard bags for incineration. The spill area will be cleaned and disinfected to keep contamination under control.

(7) Closable, leak-proof containers with appropriate markings or red biohazard bags are available in the lab for all contaminated waste.

4. Personal protective equipment (PPE).

(a) PPE, in addition to engineering and work practice controls, must be used to protect individuals against exposure to bloodborne pathogens. Worn properly, PPE provides a barrier between contaminated equipment and the user.

(b) PPE available to ALSERP investigators includes rubber and leather gloves, lab coats, face shields, goggles and masks. Items of PPE available through the Fort Rucker central issue facility are coveralls, rubber boots and jackets.

(c) The ALSERP field kit, utilized during accident site visits, contains the minimum equipment for protection including surgical gloves, utility gloves, hydrogen peroxide, disinfectant wipes, goggles, and biohazard bags. Additional PPE will be brought to the site by individual team members or obtained at the site from the central accident investigation (CAI) team.

(d) The following precautions will be observed when utilizing PPE.

(1) The amount of PPE worn is dependent on the anticipated degree of exposure. For example, masks and eye protection will be worn when eye, nose or mouth contamination can be reasonably expected. Face shields will be worn when splashes, spatters, or droplets of blood or other infectious materials pose a hazard to the eyes, nose or mouth.

(2) An accident site bloodborne pathogen survey will be conducted by the president of the CAI board in order to establish the biohazard nature of the wreckage area. ALSERP team

members will abide by the degree of control exercised by the CAI. The ALSERP team will determine the degree of hazard protection when investigating a case at the lab.

(3) Gloves will be worn when handling or touching contaminated items or surfaces such as the lab counter top. They will be replaced when torn. Disposable gloves will not be decontaminated. Utility gloves may be decontaminated for reuse if their integrity is not compromised in the process.

(4) Don and doff PPE in a particular manner to insure skin and articles of clothing are not exposed to biohazard.

(5) Remove PPE before leaving the work area and when garments become contaminated. Wash your hands with soap and water as soon as possible.

(6) Place contaminated PPE in the designated area of the lab (ALSERP corner with sink) or at the designated area at the accident site. When storing, washing, decontaminating or incinerating the items they will be contained in an appropriate red biohazard bag.

5. HOUSEKEEPING.

a. The area of the ALSERP lab where case investigations takes place will be cleaned and decontaminated after each use. The following procedures will be followed:

(1) Exam paper will be placed on the lab counter top prior to beginning an ALSERP case investigation. Containers with the mishap ALSE will be placed on the exam paper and opened. Items of ALSE and the container they arrived in will be placed in a red biohazard bag as they are discarded. Upon completion of the exam all disposable PPE will be placed along with the exam paper in a red biohazard bag. The counter top, sink, and all tools and equipment used in the investigation will be disinfected prior to their being placed outside of the work area. This includes tape recorders, clipboards, and cameras etc. Contaminated laundry such as lab coats will be washed in the facilities located in the vivarium. Do not take personal contaminated laundry home. Biohazard bags will be marked for incineration.

(2) Rules of thumb.

(a) The accident scene and the ALSE is contaminated.

(b) You are clean.

(c) Keep clean things clean.

(d) Avoid contaminated things.

(e) PPE is meant to keep the team member clean.

(f) Anything contaminated stays inside the biohazard bag.

(g) Don't bring contamination out of the contaminated area.

6. LABELING. Red color coding and or biohazard labels are used to label hazardous items and to reduce the risk of unnecessary exposure to contaminated equipment.

a. The refrigerator in the ALSERP lab office has a biohazard label affixed to the front alerting everyone that infectious material may be contained inside. Also, food and drink will not be maintained in that refrigerator.

b. The following items will either be placed in a red biohazard container or labeled with a biohazard warning. Containers used to ship ALSERP equipment to USAARL; contaminated disposable PPE; contaminated mishap ALSE after it is inspected; and contaminated laundry.

7. POST EXPOSURE PROCEDURES. The procedures in this appendix are intended to reduce the risk of occupational exposure. In the event an exposure occurs, however, the following procedures are mandatory. The person exposed will receive a post-exposure examination from a USAARL flight surgeon. As a minimum, the examination will include:

a. Documenting the route of exposure and how the exposure occurred.

b. Collecting the exposed investigators blood and testing it for HIV and HBV serological status.

c. Obtaining consent and testing source individuals blood as soon as possible to determine HIV or HBV infectivity if able. These results may be obtained from the assigned accident investigation flight surgeon.

d. Provide the exposed individual with these results

e. All documentation will be maintained in the individuals lab record and maintained IAW paragraph 9 below.

8. TRAINING will be conducted annually. An assessable copy of the OSHA bloodborne pathogen program rules and explanation of its contents will be available. Include in the training:

a. An explanation of the epidemiology and symptoms of bloodborne diseases and their mode of transmission.

b. A review of the ALSERP bloodborne pathogen program including precautions, exposure control plan, housekeeping, post-exposure procedures and signs and labels.

c. The identification of the tasks that investigators do that place them in a position to potentially experience occupational exposure.

d. Location, removal, handling, decontamination and disposal of contaminated equipment.

e. Information on the HBV vaccination including availability, its efficacy, safety, benefits and that it will be administered at no cost to the individual.

f. Training records will be kept for three years and include training dates, summary of the training and the name of the trainer.

9. RECORDKEEPING. In addition to each ALSERP investigators health record maintained at a particular health facility, USAARL will maintain a record on each individual containing the following:

a. Name and social security number.

b. Hepatitis B vaccination status including dates. Should the employee decline vaccination, the written declination will be maintained in the file.

c. Results of examinations, medical testing, evaluation and followup procedures associated with previous post-exposure procedures.

d. These records will be kept confidential in the ALSERP lab filing cabinet and maintained for at least the duration of employment plus 30 years.

APPENDIX E.

Aviation Life Support Equipment (ALSE)
Review Forms

ACCIDENT NOTIFICATION WORKSHEET

LOG

HELMET REVIEW FORM

SRU-21P REVIEW FORM

ENERGY-ABSORBING SEAT DATABASE

DISPOSITION

Appendix F.

Reference Publications

AR 95-1	- Flight regulations
AR 385-32	- Protective Clothing and Equipment
DA Pam 385-40	- Aircraft Accident Investigation and Reporting
DA Pam 738-751	- The Army Aviation Maintenance Management System - Aviation
FSC C-6545-ML	- Medical Sets, Kits and Outfits (Components)
SC 1680-99-CL-A02	- Survival Kit, Hot
SC 1680-99-CL-A03	- Survival Kit, Cold
SC 1680-99-CL-A04	- Survival Kit, Overwater
TM 10-8415-206-13	- SPH-4 Helmet
TM 11-5820-800-12	- PRC-90
TM 38-230-2	- Preservation and Packing
TM 740-90-1	- Administrative Storage of Equipment
TM 10-1670-1	- Survival uses of the Parachute
TM/TO 14P3-1-112	- Maintenance Instruction, Nomex Flight Gear
FM 1-302	- Aviation Life Support Equipment
FM 55-408	- Maintaining ALSE
CTA 50-900	- Clothing and Individual Equipment

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