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Rescue and Recovery in the Space Age (Search, Rescue and Recovery)

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Summary

This paper will be presented by Colonel Emil G. Beaudry, Vice Commander, Aerospace Rescue and Recovery Service. It will include a statement of the present Aerospace Rescue and Recovery Service mission and how it relates specifically to our country's various space programs, past, present, and as far into the future as we can project.

It will cover the introduction of the HC-130's into the Aerospace Rescue and Recovery Service inventory, the Fulton System and its potential, the possibilities of air-to-air recovery and the entirely new concepts of air-to-air refueling of the HH-3 helicopter from the HC-130H aircraft and mid-air recovery of aerospace hardware and personnel. It will conclude with an investigation of our need for rescue in space as a logical extension of the historic ARRS humanitarian approach to people in distress within the sensible atmosphere. Each of the general areas will be investigated in depth.

The Mission

The name, Aerospace Rescue and Recovery Service (ARRS), is a new one. Up until the first of this year (1966), and for the 19 previous years of its history, the command was known as the Air Rescue Service. A part of the Military Airlift Command -- formerly known as Military Air Transport Service -- it constitutes the Air Force's primary search, rescue and recovery force. As set forth in Air Force Regulation 23-19, the command's primary mission is to search for, locate and recover personnel and aerospace hardware in support of USAF and other DOD global aerospace operations, including recovery support with regard to research and development projects and programs. This fundamental aspect of the mission is the one to which the major portion of this paper will be directed.

Another important aspect of the ARRS mission -- and one that could conceivably have a vital impact on anyone living within the continental limits of the United States -- is responsibility for the coordination of all search and rescue activities throughout the nation.

In February 1961, Rescue was assigned the inland search and rescue functions by the United States Air Force. To handle this responsibility, the Zone of the Interior was divided into three sections and in each of these there is currently an Aerospace Rescue and Recovery Center. The Eastern Center is located at Robins AFB, Georgia; the Central at Richards-Gebaur AFB, Missouri and the Western at Hamilton AFB, California. These centers work together in coordinating search activities to insure that all rescue forces in the United States can be brought to bear as needed to provide protection for the life and property of all who dwell in the United States.

Depending on the nature of the situation, these centers can call upon any agency of the federal government having the capability to assist them in the prosecution of their mission. This includes the Army, Navy, Coast Guard, Marines, Forestry Service and Civil Air Patrol, as well as other Air Force agencies. In addition, state and local agencies such as the police, sheriff and fire departments, along with private skin diving clubs, mountain climbers, and civilian rescue teams make their services available to ARRS when needed. The law requires federal agencies to support this program, while state and private organizations do so on a purely voluntary basis.

To date, under widely varying circumstances, all these agencies have helped in the overall search and rescue mission. Should you, as a hunter or fisherman, private pilot or, of course, a military pilot, find yourself in difficulty, ARRS and the multi-skilled agencies mentioned above stand ready to commit their personnel and considerable resources to finding and assisting you as an individual.

Local Base Rescue and Fire Suppression

Another very important ARRS function involves the control of the local base rescue program. At sixty-one high priority bases around the world, local base rescue detachments (now called Aerospace Rescue and Recovery Detachments) perform a unique role and perform it remarkably well. The detachments fly the Kaman HH-43B Huskie helicopter. These units at their respective bases stand continual alert ready for immediate response to emergencies in the area. They are located at bases where traffic is heavy,

such as training bases; and, since Rescue took over the program in 1961, they have run up a remarkably high score of saves.

The Huskie helicopter was the first to use a new technique for suppressing aircraft fires. The unusual rotor configuration of this helicopter makes it admirably suited to its job. The rotors are mounted side-by-side, are synchronized and turn in opposite directions to neutralize torque. The rotor wash, which is directed slightly forward and swirls outward, enables firemen to make maximum use of the cooling blast of fresh air which blows away smoke and helps spread the foam that smothers the fire. Its maneuverability and hovering power help to make its foam supply and fire extinguishing methods highly efficient.

The Huskie carries a round fire tank known as a fire suppression kit for this purpose. It is a 1,000-pound device with water and foaming agents that mix into about 850 gallons of foam. The kit is carried aloft dangling from the helicopter's cargo hook. While suppression is the primary objective, if the scene of the fire is inaccessible, or if the ground units are delayed, the HH-43 can extinguish many sizeable fires without assistance. The system combines the speed and agility of the helicopter over rough terrain with the fire fighting ability of a fire or crash truck. Since taking over the LBR mission, these units have saved more than 1,500 lives.

The newest helicopter in the Rescue inventory, the Sikorsky HH-3, has also tested this fire suppression technique with great success. Because of its size and power, its massive, high velocity rotor downwash has a remarkable effect in subduing the flames and driving them back from the passenger compartment or cockpit of a downed aircraft.

The Reserves and Hurricanes

ARRS is also responsible for providing supervision of training and flying safety programs for five Reserve Aerospace Rescue and Recovery Squadrons located at Homestead AFB, Florida; Luke AFB, Arizona; March AFB, California; Portland IAP, Oregon and Selfridge AFB, Michigan. The Reserve squadrons currently fly the HU-16 aircraft; however, the squadrons at Selfridge and March are slated for early conversion to the HC-97. During the past years these squadrons have participated in almost every type of mission that ARRS has been required to support. In order to utilize these resources for preplanned missions, Reservists must volunteer to accept the flights, find the crew or crews and obtain Continental Air Command approval to allocate the man days required. In case of an emergency SAR mission, though a crew or crews may be launched without prior approval from CONAC, CONAC is notified as soon as practicable in the course of the mission. Considering the nature of the Reserve squadron operation and the fact that the Reservists do not maintain an alert posture, their response and speed into action on actual missions has been remarkable. They have typical Rescue esprit de corps and this is of fundamental importance. Participation in these missions provides realistic training and gives the Reserve units a sense of belonging to the Rescue team.

One little known Rescue mission that falls primarily on the shoulders of the headquarters and Eastern Aerospace Rescue and Recovery Center is that of hurricane evacuation. ARRS prepares the joint military aircraft hurricane evacuation plan for the continental United States and this is not a simple task. In the event that a hurricane threatens, as many as 6,000 military aircraft from 117 eastern and gulf coast bases are programmed to deploy to refuge bases elsewhere in the country. Working out the many details involved in such a plan presents numerous problems. Consideration must be given to types of aircraft involved, fuels required, ranges, runway lengths, and numerous other variables directly dependent on the nature of the threatening storm and the types and missions of aircraft in jeopardy.

Background

Primarily, ARRS thinking is oriented to the recovery of the downed combat aircrewman. As far as we are concerned, this basically is the name of the game. The United States has traditionally stood in the vanguard of nations placing a high value on human life. While the search and rescue concept is essentially a humanitarian function, it has many very real and very practical military advantages. Resources, both personnel and equipment, available to a nation are always limited. When they can be saved or recovered, especially in combat, it is, literally, a vital contribution and saving.

Dramatic lessons learned in World War II proved the value of making positive efforts towards the recovery of these resources whenever possible and practical. Over and above the actual monetary value of the recovered resources are the intangible benefits which accrue as a result of successful recovery. Not the least of these are an increase in combat effectiveness due to preservation of combat resources, improved morale of crew members and heightened mission dedication.

Another fallout is the regional, national and international goodwill generated as a result of SAR recovery operations. Experience over the years -- in war and peace -- has proven that SAR recovery forces, properly oriented, provide a significant contribution to the furtherance of our national interests.

In the archives in our headquarters at Orlando AFB, Florida, there are literally hundreds of letters from heads of foreign governments and from grateful foreign nationals that testify to the impact our humanitarian missions have had throughout the world. From Thule in the north to New Zealand in the south, Turkey to the east, and Vietnam and Japan to the west, Rescue crews have served as unofficial goodwill ambassadors in the performance of their routine duties.

Rescue helicopter pilots saved over 40 lives during recent floods near Aviano, Italy. Late last year, raging fires destroyed over one square mile in the city of Misawa, Japan. The local base rescue unit helicopters and ground crews fought the flames for twenty-seven hours without rest. The lives and property they helped save are incalculable.

A crew member aboard the Japanese fishing boat "Taihei Maru" had his left arm severely mangled by a shark. A Rescue aircraft intercepted the boat far at sea and two pararescuemen jumped into 15-foot waves, with more sharks in the area, carrying five pints of whole blood. The transfusions and other medical aid they rendered saved the man's life.

Goodwill Ambassadors

These are but a few random examples but they underscore a simple, blunt fact -- wherever Rescue aircraft fly, American prestige increases; wherever a life has been saved, or help made available, the American people have gained friends.

In many areas of the world, the gold-banded aircraft of the Aerospace Rescue and Recovery Service are the only ones permitted to fly across international borders without prior clearance. In these troubled times, with stress and strife the rule, rather than the exception, this uncomplicated, unmistakable evidence of goodwill and humanitarian purposes of the American people is a salutory thing.

Organization

Rescue and Recovery forces constitute an essential element in the total aerospace posture of the United States. To perform the many parts of its mission, the Aerospace Rescue and Recovery Service has 98 units strategically placed around the free world at 86 locations in the United States, Guam, Okinawa, Panama Canal Zone and 17 foreign countries. Within the command, in addition to the headquarters, there five major Rescue and Recovery Centers, one Aerospace Rescue and Recovery Group, 14 Aerospace Rescue and Recovery Squadrons and 70 Aerospace Rescue and Recovery Detachments. Sixty-two of these detachments perform the local base rescue function described above, seven are Rescue and Recovery Coordination Centers, and one is a fixed wing aircraft detachment. In addition, there are six Operating Locations at which an officer maintains liaison with a supporting facility.

As far as history is concerned, the need for an organized rescue service became apparent during World War II but it was not until the Korean War that Rescue, as we think of it today, became of age. During this conflict Rescue units were credited with saving nearly 10,000 people, 1,000 from behind enemy lines. No unit in the entire Air Force received a higher number of personal citations. Today in Vietnam, fighting an entirely different type war, this brilliant combat record is being maintained. So far, ARRS units in Vietnam have chalked up over 140 combat saves and these same units have been credited with nearly 300 saves of Vietnamese civilians in situations of peril.

On January 19, 1966, President Johnson awarded the 38th Aerospace Rescue and Recovery Squadron the Presidential Unit Citation for "extraordinary gallantry." The citation accompanying the award reads: "The personnel of the 38th Air Rescue Squadron distinguished themselves by extraordinary gallantry in connection with military operations against an opposing armed force in Southeast Asia from 1 August 1964 to 31 July 1965. They repeatedly jeopardized their own lives by exposing themselves to hostile air and ground fire while flying unarmed aircraft in order to rescue survivors downed in hostile territory. Their actions have directly resulted in saving the lives of 74 persons during the period reported. The extraordinary heroism displayed by this unit in effecting rescues under the most perilous of circumstances has had a most beneficial effect upon the morale of all who fly over hostile territory in Southeast Asia. By their gallantry and untiring devotion to duty, the personnel of the 38th Air Rescue Squadron have reflected great credit upon themselves and the United States Air Force."

Since the organization of ARRS in May 1946, its forces have rescued some 12,000 people from certain death and saved 88 aircraft from destruction. In addition, Rescue personnel have directly aided more than 56,000 people and 49,000 aircraft. In doing this the command flew over 103,000 different mercy missions and logged nearly three quarters of a million flying hours and the pace keeps increasing. Our present rate exceeds 20,000 missions a year.

The Tools to Do the Job

To accomplish its missions, ARRS uses a variety of aircraft. First the ancient but reliable HC-54D Rescuemaster. This is essentially the old DC-4 which was used by the airlines during the later stages of World War II and the early post war period; and, after all these years,is gradually being phased out of the Rescue inventory. It is a four-engine aircraft which is especially modified for Rescue missions. This airplane was built by Douglas and the fact that some of the aircraft are older than some of our crew members testifies to its sturdiness and reliability.

Another old workhorse and a veteran of two wars as a Rescue aircraft is the HU-16B Grumman Albatross. This is a twin-engine triphibian which can operate from land, water, or ice and snow. It has a 2,500-mile cruising range at 160 miles an hour. It is specially configured and equipped with electronic gear for Rescue missions. This aircraft is scheduled to be phased out of the ARRS inventory during fiscal year 1968.

The Kaman HH-43B Huskie has been mentioned earlier; the specially armored and higher powered version of this aircraft -- the "F" model -- is currently in service in Vietnam. The HC-97G Strato-Rescuer was made by Boeing.

It is now serving in the ARRS aircraft inventory as an interim aircraft to meet rescue and recovery needs until we are fully equipped with our newest aircraft, the Lockheed HC-130 Hercules.

The HC-130H will soon become the primary fixed wing Rescue aircraft. It has a very long range, speeds of more than 300 miles an hour and is able to cross the Atlantic non-stop and the Pacific with one stop. It is powered by four turbo-prop engines and is fitted with specialized rescue equipment including a personnel retrieving system which will be gone into later in some detail. This aircraft can land and take-off from comparatively short runways and will significantly enhance ARRS ability to rescue personnel and recover equipment globally. It is slated to play a key role in the recovery of future astronauts and aerospace equipment.

Finally, the HH-3 Sikorsky helicopter is being added to the fleet and is slated to complement the HC-130 to form a two aircraft team capable of recovering men and hardware anywhere in the world under most weather conditions. This team concept will also be discussed in detail later in the paper.

ARRS Aerospace Involvement

Pararescue

ARRS has been involved in our nation's various aerospace programs from their earliest conception. Key to this involvement has been our world famous pararescuemen and the inclusion of SCUBA (Self Contained Underwater Breathing Apparatus) training to their other skills and disciplines. Precision parachutists, highly proficient medical technicians, and experts in survival, it was not until they learned to jump from aircraft with SCUBA tanks beneath their parachutes that they acquired a true operational capability in the open sea. It is this capability that has established them, over a period of years, as being instrumental in the recovery of aerospace hardware.

The pararescuemen are among the toughest physical specimens in the Armed Forces today. They are trained to near perfection and in practically any other branch of the service, the daily routine of the pararescueman would be considered worthy of commendation. For them no special recognition is required. This is the life they love, this is the career they chose and they would not have it any other way. The wide variety of programs in which they have been involved has seen them pump in the Pacific, the Atlantic and the Gulf to retrieve numerous camera cassettes ejected from a wide variety of missiles and numerous other objects generically classified as "space age hardware."

Unique was their recovery of the first winged vehicle to return from space -- one of the Assett spacecraft. This recovery was particularly noteworthy because inspection of the vehicle itself was considered essential in determining the reaction of some twelve different metals to high reentry temperatures.

The SCUBA-equipped pararescueman, ready to go out the door, carries as much as 180 or 190 pounds of gear -- frequently more than his weight -- when participating in space recovery missions. Over his rubber wet diving suit, helmet and booties, he wears two tanks, his hose, regulator and face mask, two parachutes -- one a reserve for emergency use in case the main chute fails to deploy, two life preservers to help him float should he get into difficulties in the open sea, ten or more pounds of weight to help him sink should he choose to swim under water, swim fins and surface snorkel, life raft, diver's knife, a medical kit and whatever special tools might be required for the particular mission.

Along with Rescue aircraft and aircrews, pararescuemen have stood by on the launch pads and throughout the world to provide coverage on all the manned flights of the Mercury and Gemini programs. Even now they are training for their roles in Apollo and the Manned Orbiting Laboratory programs.

In the Mercury program, pararescuemen were the first to reach Scott Carpenter after the Aurora Seven flight splashed down and they were credited with saving the listing spacecraft by attaching the flotation collar before it could sink.

ARRS pararescuemen were also first to reach Astronauts Grissom and Young at the completion of the GT-3 flight and assisted Navy frogmen who arrived on the scene later in attaching the flotation device.

Typical Deployment

During a typical manned flight ARRS forces are deployed globally and are on alert at as many as twenty different locations. They are charged with the following responsibilities: to conduct contingency recovery operations at any point on the global track of the spacecraft in the event of a landing outside the primary landing area or planned landing areas; to provide the primary means for astronaut recovery in the entire launch site recovery area in the case of an abort on the pad or after liftoff during the first minutes of powered flight and to conduct recovery operations in the North American area and to play a major role in the conduct of recovery operations in the planned landing areas.

To meet these responsibilities as many as 50 aircraft are involved and 600 ARRS personnel, including as many as 100 of the command's pararescuemen.

As commander of the Aerospace Rescue and Recovery Service, Colonel Allison C. Brooks, is responsible for recovery operations in the North American area for the Chief of Staff, USAF. He is also charged with evaluating

all Air Force resources for the DOD Manager used to support the manned space flight operations. Operational control of ARRS forces assigned to a manned space flight recovery mission is exercised by this DOD Manager, either directly or through the military commander in chief, or his agent, in specific geographical areas.

Operational control of the ARRS forces is broken down into areas of responsibility. In the Atlantic area, this is exercised by Commander Task Force 140 as agent for Commander in Chief, Atlantic. In the European/African area, ARRS forces are controlled by the Commander of the Atlantic Aerospace Rescue and Recovery Center who is the agent for the United States Commander in Chief, Europe and Commander in Chief, United States Strike Command/United States Commander in Chief, Middle East, Africa South of the Sahara. In the Pacific area, ARRS forces are provided by the Pacific Aerospace Rescue and Recovery Center to Commander Task Force 130 who is the Gemini recovery agent for Commander in Chief, Pacific. In the South American area, ARRS forces are controlled by the ARRS Recovery Control Center at Albrook AFB, Canal Zone, for the United States Commander in Chief, Southern Command.

Launch-Recovery Mission

For the launch-recovery mission, ARRS has organized Detachment 15, Eastern Aerospace Rescue and Recovery Center, at Patrick AFB, Florida. This detachment at Patrick is responsible for providing all our recovery forces in the entire launch site recovery area. This, of course, includes pararescuemen. The helicopters from this unit provide the primary recovery and transportation means in the launch site recovery area.

This detachment operates the new HH-3 Sikorsky helicopter mentioned previously. This twin-turbine, all-weather amphibious helicopter is specifically designed for duty as an aerospace rescue and recovery aircraft. It has a hydraulically operated rear ramp for straight loading of equipment or, in an emergency, astronauts. It is a long-range heavy duty helicopter with a relatively high cruising speed of 140 knots. It has a 10,000-pound capacity external cargo hook, a 2,000-pound capacity cargo winch and a 600-pound personnel hoist for use in case sea conditions are too turbulent or terrain is too rough, or trees too tall to permit it to land and effect a rescue. Incidentally, a newer version, the HH-3, with greater power, armor plate, camouflage, and other combat modifications, is currently in action in Vietnam.

During our manned space flights, should an emergency occur during the launch situation, these helicopters, already airborne and carrying pararescuemen, would be immediately available and on the scene. Just before lift-off a command helicopter and two airborne recovery helicopters proceed parallel to the flight azimuth of the Gemini launch vehicle and should a recovery situation develop, the command helicopter would be able to coordinate and direct the appropriate air or surface forces to the scene as required. One back-up helicopter will follow the two primary recovery helicopters throughout the entire launch. Land and water vehicles will provide back-up for these helicopters.

In the case of an abort on the pad or after lift-off during the first 30 seconds, it is expected that the launch site recovery commander in the command helicopter would be able to observe the abort from his airborne position. He will then determine whether or not the booster or fuel constitutes a hazard to recovery forces. If such a hazard does not exist he will then vector in the nearest recovery helicopter to effect a pick-up.

Since the two-man Gemini capsule provides a separate means of ejection for each astronaut, their landing points could be widely separated. The dual helicopter capability plus back-ups must exist in order to effect simultaneous recovery of both astronauts. To help the recovery commander direct recovery more effectively, the parachutes of the two astronauts are distinctly marked in different colors.

Realistic training exercises, including actual recovery of air-dropped dummies, are conducted prior to any manned flight to insure that all personnel are familiar with the various recovery situations which may be encountered. Should an emergency develop causing the astronauts to eject, pararescuemen will be aboard each helicopter to provide rescue swimmers immediately to assist both astronauts after landing, helping them to stay afloat and disengage their parachutes.

The "Team Concept"

I should now like to touch on the aforementioned "team concept." Tests have substantiated that the HC-130H can be utilized as a tanker for aerial refueling of the HH-3 helicopters. A modification of the helicopter and the '130 is currently in progress.

During the refueling maneuver, the '130 refueling aircraft deploys a drogue from a pod located outboard the engine nacelles. The refueling hose trails out approximately 75 feet aft of the pod and substantially below the tanker aircraft. The operation takes place at approximately 105 to 120 knots; the fueling probe on the helicopter is a boom protruding from the nose. It is 197 inches long, braced for stability but easily detached from the helicopter when missions are to be flown which do not require air to air refueling.

This new technique has proved eminently successful and promises almost unlimited range for these big, twin-jet helicopters. It paves the way for extended ferry flights and long distance operational missions heretofore considered impossible. Rescue and recovery operations could be accomplished in the most remote areas in the arctic and antarctic or other hostile environments.

In Vietnam it will permit the helicopters to loiter in the vicinity of target areas for prolonged periods of time and respond instantly should one or more of the strike aircraft become disabled. In support of our aerospace programs, it is entirely likely that this technique could be utilized to recover astronauts and their spacecraft from anywhere on the earth's surface. While on this subject -- tests have already been conducted here in the Patrick AFB area to determine the capability of the HH-3 helicopter to lift the Gemini capsule from the water at max gross weight and carry it for sustained periods without difficulty.

This command has recently supported preliminary testing and developing to demonstrate the ability of the HH-3 and other larger helicopters to lift and transport the MOL Heat Shield Qualification Gemini B spacecraft for long distances over water. Once this ability is demonstrated it is possible that this helicopter concept could be utilized in the entire MOL astronaut and spacecraft recovery program and subsequently with heavier lift helicopters to effect all spacecraft and astronaut recovery requirements in the future.

In an actual astronaut/spacecraft recovery mission, two helicopters at least would be required along with an appropriate number of refueling aircraft depending on the range involved. The helicopter with the astronauts and accompanied by the refueling aircraft could fly to the nearest appropriate base following their splash down and recovery. The other helicopter carrying the spacecraft would have to fly at a slower speed and in all probability would have to deploy spacecraft periodically in order to achieve speeds necessary for air to air refueling. Future tests are planned to obtain more detailed empirical data on this phase of the operation.

An interesting aspect of the new air to air refueling technique is that once the helicopter has approached the area of the drogue trailing behind the tanker aircraft, it can reduce power significantly -- in some instances to just a fraction of what was first required to fly formation with the tanker. Once it reaches the refueling position, the vortex of the tanker aircraft's airflow literally drags the helicopter along with it. This is a phenemenom very similar to that seen in stock car racing where one auto draws in and holds his position close behind the leading car in a routine maneuver popularly called "drafting." In both instances the trailing vehicle is able to keep pace with the lead even though it requires substantially less power.

Through the utilization of multiple in-flight refueling, a ferry range of the HH-3 can be extended to a range limited only by the crew fatigue factor. On missions of this sort, plus extreme long range rescue and recovery missions, the normal crew of three would be augmented by an additional pilot to minimize fatigue.

New Gear Enhances Space Recovery Role

The introduction of such new equipment as the HH-3 and the HC-130 into the inventory and the development of new techniques made possible by this new equipment virtually assures the fact that ARRS participation in future space programs will be greatly enhanced. The HC-130H, for example, will have a range and speed significantly exceeding that of present rescue aircraft. In search and recovery operations, such as would be flown during a typical NASA mission, it will be capable of flying out well over 2,000 miles, loitering for a significant period of time and pinpointing the spacecraft landing area with its complex Cook Electric re-entry tracking gear.

The tracking gear, identified as an AN/ARD-17, is used to search for and track signals in the UHF and SHF spectrum, and provide a permanent printed record of tracking data. The set also furnishes visual indications of the strength, spectrum and bearing of the signal being received and an audio tracking error signal.

The Fulton Recovery System

The '130 will then be able to perform recovery operations during which pilot astronauts and para-rescuemen will be snatched from the sea, hoisted aboard the aircraft, and returned to their home base. This highly sophisticated operation will use the specially developed Fulton Recovery System which is expected to be man rated in the very near future.

The system works this way: The HC-130H crew drops a recovery kit including a special zip-on survival suit, helium tanks and a balloon to stranded personnel. If aid is required, pararescue personnel are also dropped from the HC-130H. The man on the ground or in a liferaft dons the suit and inflates the ballon which is 24 feet long by 6 feet in diameter. A 500-foot nylon line lifted by the balloon is anchored to a retrieval harness on the man to be rescued.

The HC-130H flies into the wind at 120 to 140 knots true airspeed to reduce the actual ground speed and "G" loading on the recovery subject. Then the HC-130H extends a V-shaped yoke from its nose and flies a course to intercept the balloon line aiming immediately beneath the balloon. Guided by the 24-1/2-foot yoke, the balloon line is locked into the sky anchor gear in the nose of the aircraft and the balloon breaks away at a weak link. The line attached to the stranded man then is retrieved at the rear of the aircraft and is hooked to a recovery winch in the cargo compartment. The man then is reeled into the rear of the aircraft.

The subject to be recovered experiences forces considerably less than obtained during a routine parachute jump. Average recovery time from about 500 feet is five minutes. The line is placed in a special davit near the rear cargo door when the winching operation is nearly complete, and the man is hoisted inside without contacting any part of the aircraft. Special fending lines of fiberglass and Teflon extend from the nose to each wing tip to

prevent the balloon lift line from fouling in the HC-130H propellers and exposing the payload to injury.

A new overhead aerial delivery system is installed in the HC-130H for deploying rescue equipment of practically any size or shape. An intervalometer will provide automatic sequential release of survival equipment and various rescue and recovery bundles. In addition, the interior of the aircraft is modified with equipment bins for specialized gear. An automatic flare launcher will enable scanners and pilots to activate any of the ten flare launching tubes for adequate vision during night search and recovery operations.

The HC-130H will carry a crew of ten, including two pilots, a navigator, a radio operator, two flight mechanics, two pararescuemen, and two recovery subsystem operators. Three bunks are installed in the cargo compartment for use on lengthy missions.

Air-to-Air Recovery

Another technique being developed is an aerial retrieval system. It, too, is made possible by our improved equipment. It's designed to bring aboard aircraft in flight, parachute and balloon-borne objects varying in weight from 65 to 2,500 pounds. These objects would be engaged at flight altitudes between sea level and 15,000 feet and in all environments from arctic to tropic.

A similar system has been used for a number of years to recover aerospace hardware. ARRS has an immediate need for such a system to assist in meeting its responsibilities in support of the Atomic Energy Commission's High Altitude Sampling Program. The program -- utilizing balloons to carry various sampling devices to extremely high altitudes -- is somewhat hampered in obtaining optimum global coverage since the sampling devices do not lend themselves to water recovery as it is now practiced.

This proven system, installed on the HC-130H or the HH-3 will enable the High Altitude Sampling Program to increase its coverage significantly. While the system is not man-rated at the present time, an extension of this technique -- the air to air recovery of aircrew members forced to bail out over enemy territory -- is being given close examination.

It would enable Rescue aircraft loitering in the strike area to recover such stricken aircrew members as they descended in their parachutes. Such a system would have at least two advantages, the first being the ability to save the man from falling into enemy hands, the second being to reduce exposure time of the rescue aircraft to ground fire while in the recovery area.

Rescue in Space

Since a high percentage of the members attending the Congress have long since transcended thinking about operations in the sensible atmosphere, the concluding portion of the paper will be devoted to the consideration of Rescue in Space.

It is firmly believed that the Aerospace Rescue and Recovery mission is but a forerunner to the future when along with the rest of the Air Force, ARRS personnel hope to be operating in space. The present limitation to the sensible atmosphere is imposed only by the state of the art of space flight technology. Our basic mission requirement will not only remain valid but be enhanced as man progresses out into space. Rescue in Space is but the logical extension of this traditional humanitarian role.

As in all manned systems, the safety of the crew during space operations is paramount. Over the past years, as part of long-range planning for manned space flight, space rescue has been the subject of various studies and a great amount of research work. In recent months, the tempo of NASA manned flights in Gemini and the actions related to the DOD Manned Orbiting Laboratory have given added impetus to a review of space rescue considerations.

The task of insuring crew safety is a never-ending one, primarily because of an inability to foresee and prepare for all possible emergencies. Current emphasis in providing crew safety has been placed on the trouble-free operation of the basic space system by minimizing risks and providing maximum reliability in all subsystems. Logical extension of effort for providing crew safety includes providing means for abandoning or aborting a malfunctioning space system at any point of its operations and safe return of the crew to earth, as well as providing a means of rescuing a crew stranded in space. It is a problem we all know will one day confront us -- inevitably.

Certain contractors have generated interest by publicizing their in-house studies on rescue needs and concepts. Michael Stoiko of Martin Company set forth a most persuasive case for space rescue in a lecture at an international space meeting in Athens, Greece, some several months ago. In a most meticulous analysis of planned space flights throughout the next 20 years, Stoiko reaches the conclusion that, statistically speaking, it is a virtual certainity that some critical emergency will occur during space flights in the next few years. In a recent article concerning Stoiko's analysis syndicated columnist William Hines of the Washington Star wrote:

"Stoiko estimated that in the next 20 years there will be about 280 manned space flights involving about 800 men. Half of each -- men and flights -- will be American, half Russian. Total flight time will be about 2.4 million manhours (compared with the world-wide total of about 1,200 manhours to date).

"Against this backdrop, Stoiko projects a grim

figure: A 62 percent probability of at least seven emergency situations involving twenty-two men in the next 20 years; a 58 percent probability of two or three emergencies in the coming decade. In terms understandable to horse players, Stoiko is laying 5 to 3 on multiple disaster by 1985, and 3 to 2 on trouble striking more than once before 1975."

Conceptually, and to a degree philosophically, some of us in ARRS have been talking about manned space stations in general and the "Manned Orbiting Laboratory" in particular with a view toward the problem of Rescue in Space.

The concensus appears to be that MOL will develop the learning curve for long duration operations in space, maneuverability, rendezvous and docking maneuvers and other techniques -- all of which are the same prerequisites for conducting rescue and recovery operations in space itself. This led to our thinking that an aerospace resuce capability operated by the USAF would permit a useful program of peaceful connotation for the MOL and other follow-on programs, which might be more compatible with current national objectives regarding a specific military requirement in space vis a vis peaceful uses of space.

Space rescue is entirely feasible and well within the known state of the art, as demonstrated by Major Edward White's Extra Vehicular Activity and the rendezvous between Gemini 6 and 7. These are the essential skills required to effect a rescue in space. There is no reason today -- or certainly in the reasonably near future -- why an operational rescue spacecraft could not be ready and standing by in the event of distress or tragedy during manned flights.

For example, a launch vehicle such as the Titan IIIC with its great weight lifting capability and mission versatility could easily carry a rescue crew, medical facilities, and technicians aloft to assist in any way required. In some instances it could effect repairs on the crippled spacecraft, if necessary, it could transfer stricken astronauts into the larger rescue vehicle for return to earch. The quick reaction potential of the Titan IIIC makes it ideal for the role of such a standby rescue launch vehicle. It can be moved to its pad at T minus 195 minutes for up to 30 days and at T minus one minute for up to six hours and then it can be launched within two seconds of a preselected launch time.

However, it must be recognized that ground based rescue is but one option among many for insuring crew safety and is probably the most difficult, complex and expensive. Experience has demonstrated that only heavy traffic volume justifies separate rescue facilities. A multi mission logistic vehicle supporting a given space-bourne system seems to be the most feasible approach for establishing a ground based rescue capability.

While actual space rescue seems, literally and figuratively, "far out" and may well be years away, one thing is certain -- someday, when some future astronaut calls "May Day" his voice will be heard. We in the Aerospace Rescue and Recovery Service would like the mission and believe that, with proper planning, tomorrow, as today, help will be available.

Search and Rescue Utilizing Satellites

Another very promising -- though less dramatic -- concept links space age technology to more traditional rescue procedures. This involves the use of satellites for search and rescue purposes. A number of proposals are currently under study in this area and they all have in common the capability of quickly determining the location of lost persons and parties in distress to a high degree of accuracy. Multiple satellites would be launched with the time of their launching carefully calculated so that every spot on the earth would be surveyed once every two and half hours. The satellites, which could also be used for navigational purposes, would be able to locate the position of small low-power emergency transmitters carried by individuals or distressed vehicles and to transmit this location back to Aerospace Rescue and Recovery stations. In addition to its value in pinpointing downed airmen, the SARS (Search and Rescue Utilizing Satellites) system could quickly locate hunters, lost fishermen, ships and boats in distress -- anyone, anywhere providing they are equipped with the small transmitter.

One proposed satellite system would locate a distress signal and record this information for later release to a central computer upon a command signal. The data would provide readout of the geographical location of the man or group in distress. A compatible low cost distress beacon would provide the facility to locate anyone, anywhere in the shortest possible time.

Envoi

For reasons of time and space, we have been able to touch on but a few of the more obvious general areas in which the Aerospace Rescue and Recovery Service is expected to move ahead.

For the first time in our history we are receiving detailed attention and consideration at the highest military and political levels. This is an enviable position to be in, but, it is not an unmixed blessing. Many people are expecting ARRS to attain greatly increased capability immediately. They are not aware of our already heavy commitments and strained resources and the fact that we are in the midst of a deficit situation. It appears likely that this situation will exist for an extended period

of time. This is because of conversion to our new equipment, the enormous impact throughout all of ARRS caused by our Southeast Asian operations, and prolonged and heavy over-commitments in our primary mission areas straight across the board. Nevertheless we are optimistic that the "can do attitude" which prevails throughout our service will insure that our operational capability will increase at a steady pace. With advanced ideas, initiative and proven capabilities the Aerospace Rescue and Recovery Service is prepared to meet the future's complex and fascinating challenges, whether they are on earth, or in the aerospace above.

Photo Captions

1. Hoist recovery operations, used to save personnel in remote and inaccessible locations, are accomplished by the Kaman HH-43B Huskie helicopter. This unique aircraft which combines both speed and agility over rough terrain and a fire suppression capability equal to that of a crash fire truck has accounted for the saving of more than 1,500 lives through its local base rescue role, both in the United States and at Air Force installations abroad. It has rescued many downed aircrewmen in Vietnam.

2. Firefighters in action. The HH-43B Huskie helicopter hovers near a flaming aircraft, blowing flames down and away from the firefighting crewmen who make their way to the cockpit with foam spray. The combination of helicopter, foam kit and highly skilled firemen makes for a fast, efficient rescue operation.

3. In a simulated crash-rescue exercise, a Kaman HH-43B Huskie helicopter carries aloft its 1,000-pound fire suppression kit. The FSK, as it is more popularly known, is capable of producing about 850 gallons of foam from its self contained supply of water and foaming agents. The HH-43B with its unique high volume rotor wash and FSK capability, plus its speed and agility over rough terrain, has contributed to the saving of more than 1,500 lives.

4. Newest aircraft in the Aerospace Rescue and Recovery Service inventory is the Lockheed HC-130H Hercules. The Hercules, soon to become the primary ARRS fixed wing rescue aircraft, combines extra long range, a speed of more than 300 miles per hour, a comparatively short landing and take-off capability and special rescue electronic tracking equipment. Special versions of this aircraft will also provide in-flight refueling capability for the ARRS jet-powered HH-3 jet helicopter. Forked device on the nose of the aircraft is part of the Fulton Recovery System which will be used for ground-to-air or sea-to-air recovery of personnel and equipment.

5. A fully equipped pararescueman may carry as much as 190 pounds of equipment including SCUBA tanks and parachutes. This is the same equipment used by all pararescuemen who take part in the various manned and unmanned NASA space projects as part of the launch area and global rescue and recovery force.

6. An aviation first. Pictures show an aerial refueling test involving a USAF Sikorsky HH-3 helicopter and a USMC Lockheed KC-130 tanker -- the first such tests ever performed involving a helicopter and a fixed wing aircraft. Success of the tests, using conventional equipment, means extended range for the new twin-jet helicopter. The technique, devised at Headquarters, ARRS in Orlando, Florida, has great potential for use in Vietnam and in support of our nation's space program.


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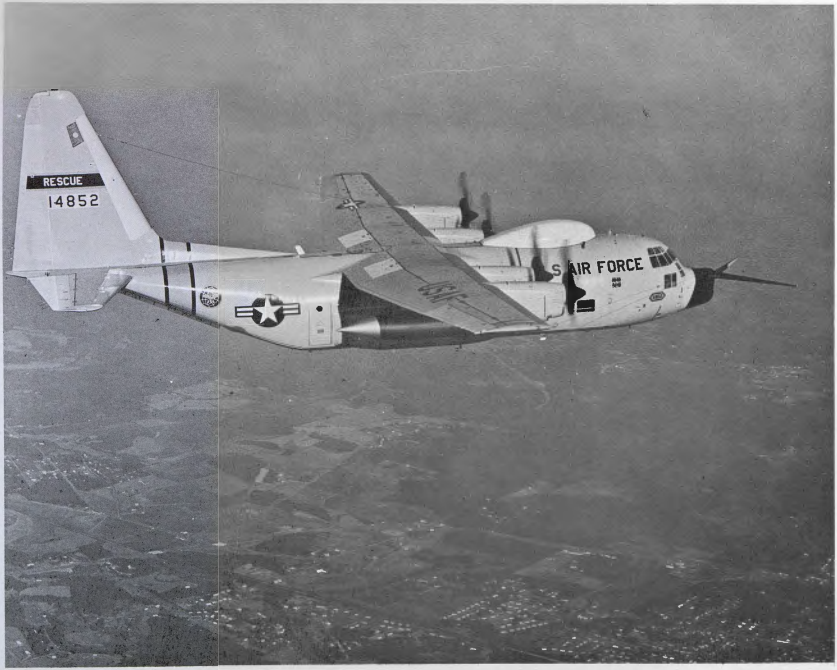
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