

## SCIENTIFIC

# Emergency Medical Operations at Kennedy Space Center in Support of Space Shuttle

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**ABSTRACT:** *The unique environment of the Kennedy Space Center includes a wide variety of industrial processes culminating in launch and spaceflight. Many are potentially hazardous to the work force and the astronauts. Technology, planning, training, and quality control are utilized to prevent contingencies and expedite response should a contingency occur.*

**E**mergency Medical Support at the Kennedy Space Center (KSC) requires a complex multifaceted approach involving several disciplines. This type of support has developed due to a variety of factors:

1. The unique environment at KSC predisposes to potential contingencies because of the variety of hazardous substances and operations necessary to support launch vehicle processing and payload functions.

2. An increasing awareness of environmental, toxicologic, and occupational safety and health concerns has elevated the roles of these considerations.

3. Technological improvements in medicine (many spinoffs from the Space Program itself) have modified the medical approach.

4. Expectations have gradually risen throughout the country regarding rescue, emergency or disaster response and medical support capabilities within any given locality or community. These expectations include the rescue of individuals while providing them state-of-the-art medical care and protection of the environment during the perilous conditions of a disaster.

Launch contingencies may be viewed as an all or none phenomenon; either everyone is uninjured or the accident is catastrophically fatal. We know, however, that there is considerable potential for many disasters that lie in between and, as we all are aware, if we do not prepare we will not perform well. There is an innate psychological need to have a fighting chance in any event. Further, others besides the crew may directly or indirectly receive injury and require attention.

The potential hazards include chemical (e.g., ammonia, freon, hydrazine and nitrogen tetroxide), fire, explosion, deceleration/impact, hypoxia, and decompression. Our approach is development of a written plan to define roles and responsibilities, maintain

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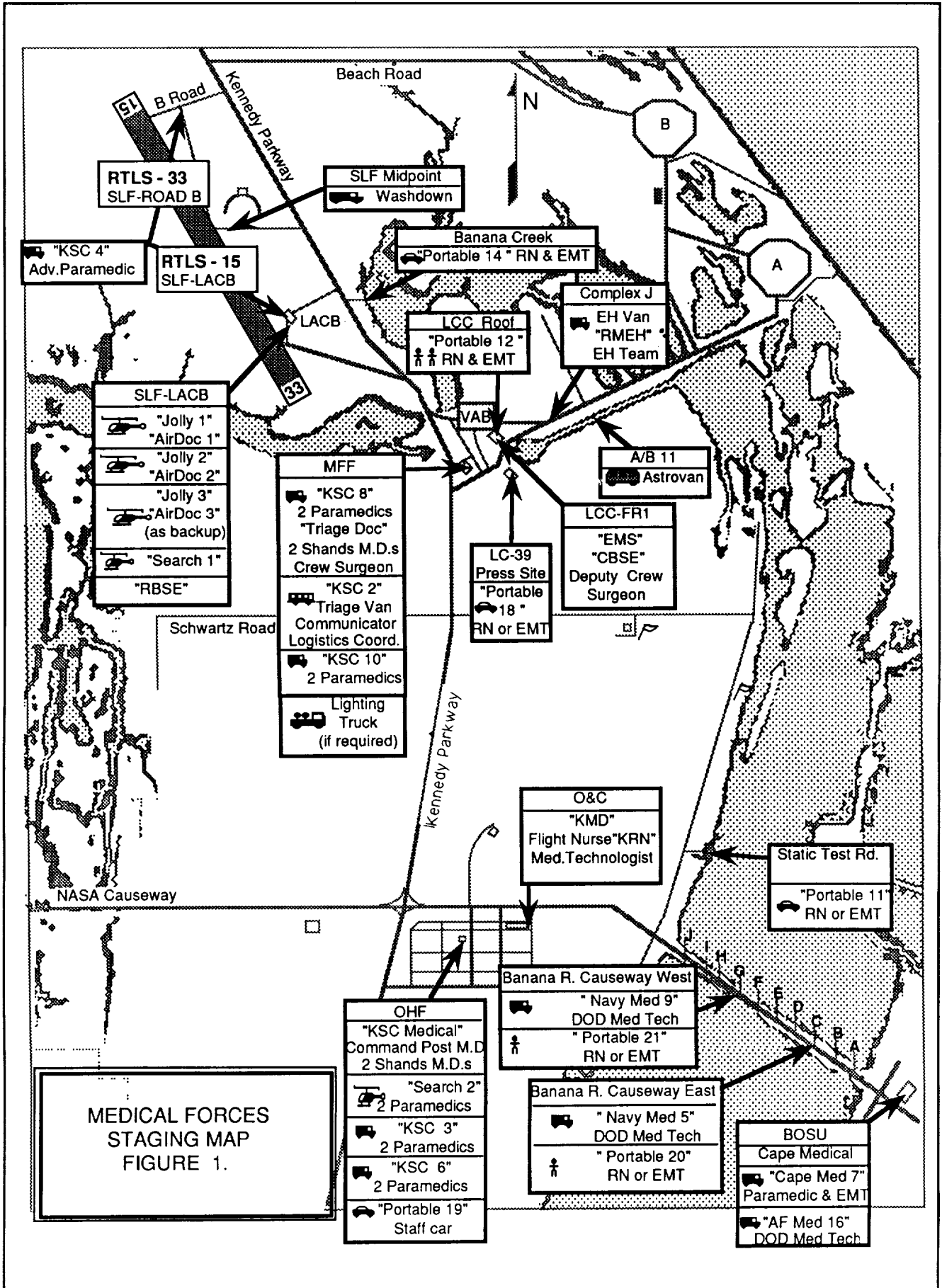


Fig. 1.—Medical forces prelaunch deployment.

organization, and serve as a blueprint for progress. It is equally important to practice this plan through rescue simulations coordinated by the Emergency Egress and Rescue Working Group.

**Emergency services** ● Those at risk at KSC include not only the flightcrew but also 20,000 other workers and up to 80,000 spectators. We have found that a coordinated team approach involving several disciplines is best. These include fire/rescue, security, medical, DOD, environmental health, safety, Shuttle operations, and the astronaut office. Medical care provision has been established along parallel lines for two groups: those in close proximity to the orbiter such as astronauts, closeout crew and landing crew, and those at greater distance such as other workers and spectators. Both lines of care are supervised by the Emergency Medical Services Coordinator (EMS), a physician, operating with real time radio communications in the Launch Control Center. The triage team headed up by the Triage Physician is staged at the Launch Area Clinic to respond to contingencies involving the Space Shuttle by establishing a predesignated triage site. A medical command post with a physician in charge is set up at the Occupational Health Facility (OHF) to handle on-going medical problems of other KSC workers and to coordinate the care of spectators. Medical forces are deployed during prelaunch staging (Fig. 1).

The EMS is assisted by the Biomedical Office Physician (KMD) located in the Operations and Checkout Building. This individual maintains a dynamic inventory of area hospital resources and facilitates hospital communications.

**Search and rescue** ● The EMS is also in communication with the DOD Support Operations Center (DOD SOC) at Cape Canaveral Air Force Station (CCAFS). The DOD SOC performs search and rescue for ocean bailouts, rescue team deployment for off-runway contingencies at KSC, and Medevac in addition to their global rescue operations responsibilities.

When Medevac is required, the EMS requests this through the NASA Landing Recovery Director for DOD HH-3 Jolly Green Giant helicopters or for NASA UH-1 helicopters.

The DOD helicopters can carry four litter patients with a medical crew of one flight surgeon and three pararescue specialists. The NASA helicopters can carry one to two patients and are staffed by two paramedics with a physician option.

Communications are maintained with Johnson Space Center (JSC) flight medicine through a variety of means: The mission's crew surgeon is a member of the deployed triage team. The deputy crew surgeon is located with the EMS at the Biomedical Communications Console in the Launch Control Center. The surgeon's communications loop (private

telephone line) is used between the EMS, DOD SOC, and JSC Flight Operations Control Room Surgeon (in Houston).

In a contingency the basic response sequence of rescue events is the following:

1. Prior to launch, a probable triage site is announced, chosen from a variety of locations based on the functioning launch pad, wind direction, and other conditions.
2. Declaration of an emergency, confirmation of triage site designation, and dispatch of forces.
3. Rescue and delivery of injured to the triage site (Fig. 2).
4. Decontamination, triage, and treatment/stabilization.
5. Medevac to definitive care.

Each triage site consists of a decontamination area and a treatment area. A washdown fire truck with attendants for decontamination, an Environmental Health Team (EH) with equipment to detect contamination, and a paramedic to monitor the Airway/Breathing/Circulatory Status (ABCs) of the injured, deploy to the decontamination area. Should a patient require immediate lifesaving treatment, the paramedic may request that decontamination be suspended and the patient be moved to the treatment area, or that a treatment team deploy to the decontamination area. Following such a procedure, all parties and areas are evaluated and decontaminated as indicated by EH. The personnel in this area wear protective gear.

The triage physician, two to four trauma physicians, the JSC Crew Surgeon, six paramedics, a medical communicator (radio operator), and a logistics coordinator (to dispense medical supplies) deploy to the treatment area.

The patients may arrive by a variety of vehicles depending upon the contingency. In prelaunch contingencies they are transported along the crawlerway by armored personnel carriers. For runway mishaps a rescue van is utilized. When the crash site is off the runway by some distance, DOD helicopter transport is required both to deploy the rescue team and retrieve the injured. The DOD Flight Surgeon, in consultation with the EMS, may then elect to go directly to the designated hospital rather than return to a triage site.

The rescue scenarios have been divided into eight modes:

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|-----------------|---|
| I. PRELAUNCH:   | Unaided egress of the flightcrew                                |
| II. PRELAUNCH:  | Egress with or aided by the closeout crew                       |
| III. PRELAUNCH: | Egress aided by fire/rescue, closeout crew no longer on station |



Fig. 2.—A simulated patient is delivered to a triage site by the rescue team at Kennedy Space Center.

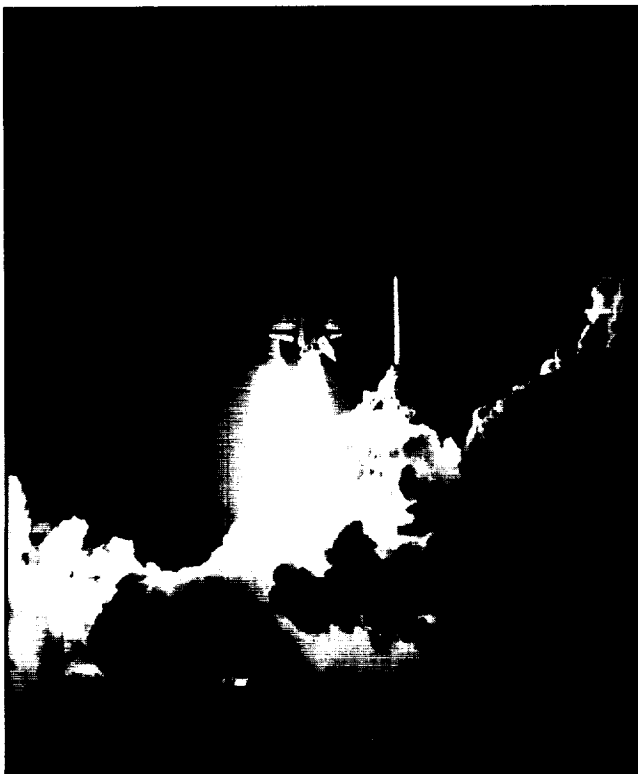


Fig. 3.—Space Shuttle launch.

IV. PRELAUNCH: Egress aided by fire/rescue with closeout crew on station

V. POSTLANDING: Unaided egress by flightcrew  
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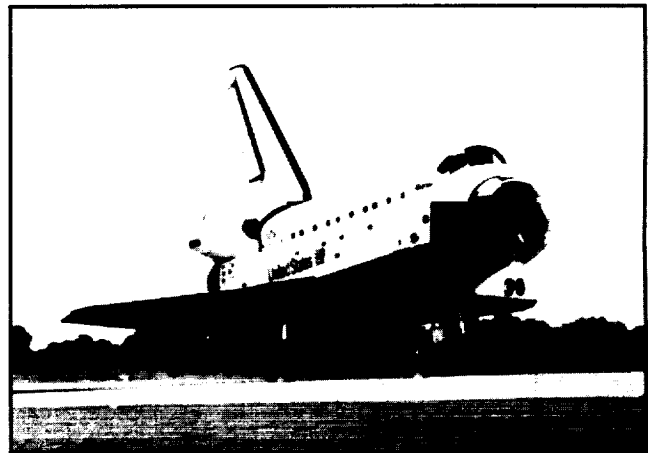


Fig. 4.—Space Shuttle Landing at the Kennedy Space Center.

VI. POSTLANDING: Aided egress following a mishap on or near the shuttle landing facility

VII. POSTLANDING: Aided egress following a mishap in a remote area on KSC

VIII. Unaided egress (bailout) in flight

In modes I-IV, the subjects proceed or are carried by rescuers from the Orbiter to slidewire baskets located at the 195-foot level on the launch pad (Fig. 2). If there is risk of fire or contamination, a deluge system will be spraying water over the entire launch complex. Astronauts who are fully suited activate

their Emergency Breathing Air (10-minute supply) as soon as a contingency is declared while others don emergency breathing devices prior to proceeding to the slidewires. After a rapid trip down the wires, they arrive near a bunker where they contact the NASA Test Director on a direct line to determine whether to stay or proceed via armored personnel carrier to the triage site. Decontamination showers, breathing air, and first aid equipment are available at the bunker.

In modes V-VI, a triage site is established 1250 feet upwind of the orbiter on the runway. In the event of an overrun or landing too short, the triage site is set up at the end of the runway closest to the crash site. The astronauts and/or rescuers egress through the side hatch with an airline type slide or climb out an emergency opening on top and rappel down the side. They are transported to the triage site by rescue vans.

For mode VII, the rescue team is deployed from DOD helicopters by landing, hoist, or rope. One pararescue specialist deploys with the rescue team to perform initial care and decontamination. The helicopter then returns to the Shuttle Landing Facility to pick up its full complement of medical personnel for patient loading. Both the rope and hoist deployments may require hoisting of the patients up into the hovering helicopter. After patient loading, the helicopter may land at the triage site for further patient stabilization or proceed with direct Medevac to a hospital.

In mode VIII, C-130 fixed wing aircraft search and rescue teams deploy with pararescue specialists who parachute into the ocean with zodiac rafts to rescue

and stabilize the injured. This is followed by Medevac on HH-3 helicopters equipped with medical teams who hoist the injured on board. In-flight refueling is used as needed.

We also provide emergency medical coverage for the other workers at KSC as well as large crowds of spectators. A medical command post operates from the Occupational Health Facility (OHF) utilizing a complement of ambulances and other staff vehicles manned by paramedics, nurses, and EMTs stationed at various viewing sites in the field (Fig. 1). This allocation of resources for astronauts and spectators helps ensure that medical support is not interrupted to either group.

This is a brief description of current KSC emergency medical operations for Space Shuttle launch (Fig. 3) and landing (Fig. 4). As long as this spaceport is charged with the signal responsibilities of space vehicle processing, launching, and landing, it will be necessary to support these potentially hazardous activities with prudent emergency medical services. Further developments are anticipated in the future as the needs, capabilities, and visions expand in this area.

### Reference Documents

Medical Operations Requirements Document JSC-13956 July 1988.

Medical Operations Support Implementation Plan, KBM-PL-1.1, August 1988.

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