

NASA Facts

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LIFTOFF over the pacific



LIFTOFF OVER THE PACIFIC

Launches from NASA's Kennedy Space Center facilities in Florida have sent human crews to the Moon and intelligent robots soaring to and past the planets. The drama entwined in these flights has tended to eclipse the more mundane—but equally important—missions launched from NASA facilities in California.

Approximately 80 NASA missions have been launched on expendable rockets from California since operations began in 1960. Expendable launch vehicle operations will continue into the mid-1980s and NASA payloads will be flown on Space Shuttle flights from the West Coast when such missions begin several years from now.

NASA's California launch facilities are located on Vandenberg Air Force Base, which occupies the Point Arguello promontory jutting into the Pacific Ocean approximately 150 miles northwest of Los Angeles and 290 miles south of San Francisco.

The land does not merge gently with the sea as in Florida and launch facilities are carved out of the foothills of the rocky Santa Ynez mountains which brood over the coast and plunge precipitously into the Pacific. Countless thousands of middle-aged Americans—World War II veterans—may remember this rugged, often fog-shrouded and picturesque area as the U.S. Army's Camp Cook.

Why does NASA need two major launch sites?

The answer rests in a combination of geography, physics and orbital geometry. NASA launch pads on the Kennedy Space Center and adjacent Cape Canaveral Air Force Station are ideally located for missions into stationary orbits or flights to the Moon or the planets. Launched into trajectories with easterly components, payloads pick up a velocity "freebie" of about 1,000 miles per hour due to the planet's west-to-east rotation, a valuable assist in escaping from the Earth's gravity. They can easily and economically be placed in stationary (synchronized with the planet's rotation) orbits over selected points on the Earth's equator. Their trajectories can easily be aligned with the plane of the equator—on which communications and weather satellites are placed in stationary orbits—and also with the plane of the ecliptic along which other spacecraft must cruise to accomplish missions to the Moon or to the planets.

But other missions—those involving low altitude weather or Earth observation satellites—require different orbits. For example, near-polar or high inclination orbits are best for Earth observation systems such as those on the Landsats. The Earth revolves west to east beneath them as they circle the planet on orbits carrying them near the north and south poles. They can thus view any given location below every two to three weeks. This repetitive and frequent coverage is essential for the completion of their missions.

Can't these missions be launched from the East Coast? Sure they can!

But the launch of polar missions from the sites on the Florida coast imposes two major penalties:

1. Satellites being placed in north-south orbits would have to be launched over heavily populated areas to the north of the Kennedy Space Center or South Florida. Modern rocket systems are reliable—but not yet reliable enough to expose the American public to the possibility of a tragic accident. This problem is compounded by the advent of the Space Shuttle, which sheds its twin solid rocket boosters at an altitude of 28 miles after two minutes of flight. The expended solid rocket booster casings impact about 160 miles down-range from the launch site and it would not be feasible to fly this system over land. A similar problem exists with the Delta, which jettisons its solid strap-on boosters during the early minutes of flight.

2. Rockets carrying satellites bound for north-south orbits could be "dog-legged" out over the ocean to avoid populated areas before placement on their final courses. This approach is difficult to accomplish. The "dog-leg" maneuver requires large amounts of precious energy, meaning that more powerful (and expensive) rockets would have to be used or the weight of the payload would have to be reduced.

It's more practical (and economical!) to launch polar orbit payloads from the California site at Vandenberg. Satellites can be launched to the south from Vandenberg to enter polar orbit without overflying populated land masses. Rockets and their spacecraft fly over huge expanse of empty Pacific waters until they soar over the unpopulated Antarctic continent.

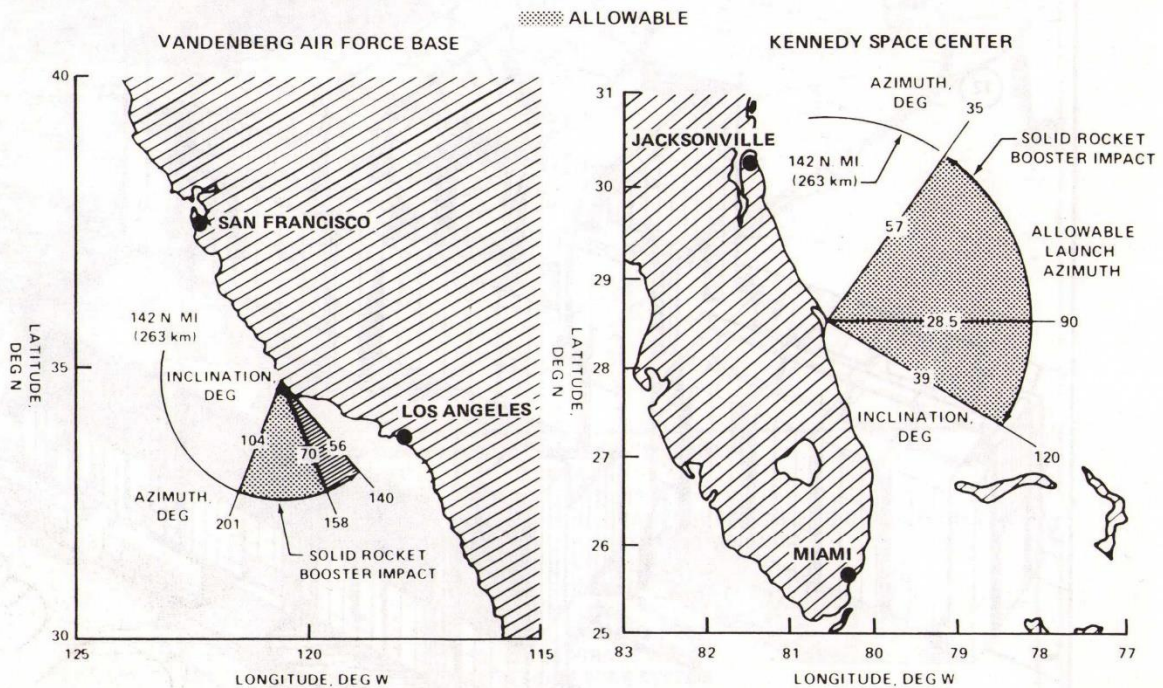
Typical of NASA-launched missions from Vandenberg over the past two decades are the TIROS, Nimbus and NOAA weather satellite series, the Landsat Earth resources satellites, Orbiting Geophysical Observatory and Explorer scientific research satellites, and a host of other satellites designed to conduct studies in a wide variety of scientific fields.

In addition to the NASA payloads and those launched for other agencies of the United States government, NASA launch teams at Vandenberg have launched missions for Canada, the Netherlands, West Germany, the United Kingdom, France, Spain, and the European Space Research Organization, now the European Space Agency.

Payloads are launched aboard the Scout and Atlas-F rockets but the workhorse of the NASA operation at Vandenberg AFB is the reliable Delta rocket, also flown from NASA pads in Florida.

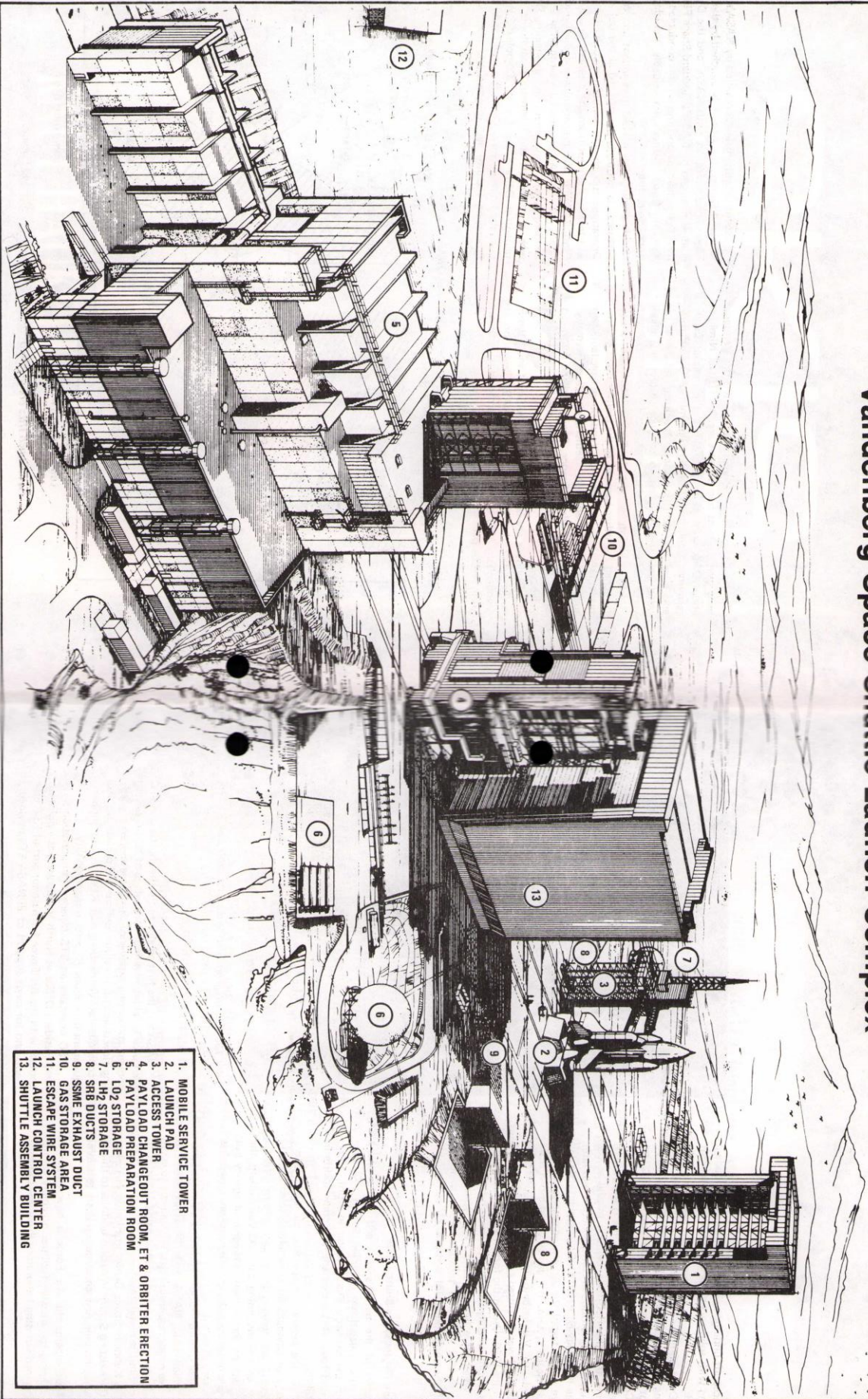
Scout operations are conducted by NASA's Langley Research Center, the Atlas-F is launched by the U.S. Air Force under contract with NASA, and the Delta program is managed by NASA's Goddard Space Flight Center. Delta launch operations are conducted by the Kennedy Space Center's Expendable Vehicles Operations Directorate.

A small cadre of KSC government and contractor personnel is permanently assigned at the Delta Western Operations Branch and supplemented by management and technical groups from the Kennedy Space Center in Florida during final preparations and the launch countdown. The NASA operations are centered in South Vandenberg, where management and engineering facilities as well as spacecraft and telemetry laboratories are maintained; at Delta Space Launch Complex 2-West, near Purisima Point in North Vandenberg, and at a Hazardous Processing Facility east of the Delta launch complex



Two launch sites are required for efficient access to Polar and Equatorial orbits.

Vandenberg Space Shuttle Launch Complex



- 1. MOBILE SERVICE TOWER
- 2. LAUNCH PAD
- 3. ACCESS TOWER
- 4. PAYLOAD CHANGEOUT ROOM, ET & ORBITTER ERECTION
- 5. PAYLOAD PREPARATION ROOM
- 6. LQ2 STORAGE
- 7. LH2 STORAGE
- 8. SRB DUCTS
- 9. SSME EXHAUST DUCT
- 10. GAS STORAGE AREA
- 11. ESCAPE WIRE SYSTEM
- 12. LAUNCH CONTROL CENTER
- 13. SHUTTLE ASSEMBLY BUILDING

where spacecraft undergo spin-testing, propellant loading and mating with solid rocket motors prior to movement to the pad.

The Delta complex stands on a rugged prominence overlooking the Pacific Ocean. The facilities resemble—but do not mirror—the two Delta pads used by KSC on the East Coast. The gantry is a hand-me-down from the U.S. Army and was originally used by the U.S. Army to develop and test the Redstone ballistic missile at the White Sands Proving Ground in New Mexico. It was later used at the New Mexico desert site during the Little Joe II program which tested the Apollo command module and launch escape system. The gantry was shipped from White Sands to Vandenberg in early 1969. It was reassembled and was first used by NASA for the IMP-G launch in mid-1969. Use of the former White Sands gantry saved approximately \$2 million in activating the facilities which have been modified and updated over the years so that it is now possible to use them for launch of the most powerful versions of the reliable Delta rocket.

Vandenberg Future Space Shuttle Base

Launches of the nation's new and revolutionary Space Shuttle began from modified Saturn V/Apollo facilities at the Kennedy Space Center in April, 1981, but a second base—at Vandenberg—will come to life in the mid-1980s.

At KSC, the program is operated by NASA and a wide variety of payloads for commercial, scientific and military users are soaring into space aboard shuttle orbiters at an ever-increasing pace. At Vandenberg, the Air Force will be the primary management agency but the payloads orbited will be scientific and commercial as well as military in nature.

The Space Transportation System is a national program in which both NASA and the Department of Defense have major responsibilities. With an eye to economy, both agencies have adapted existing facilities to meet Space Shuttle requirements.

At the Kennedy Space Center in Florida, NASA remolded the existing Saturn V/Apollo facilities to shuttle requirements, holding new construction costs to a minimum.

At Vandenberg, the Air Force is now embarked upon re-shaping the massive facilities originally created for the Manned Orbiting Laboratory Program—cancelled in 1969.



Delta 139 lifts off from Vandenberg to orbit Landsat 3

NASA was the first agency to fly the shuttle and the Air Force is taking maximum advantage of NASA development and testing experience, NASA-developed processing flow diagrams, timelines, designs and procedures. As a consequence, Vandenberg and KSC ground support equipment have about 70 percent commonality.

KSC maintains an STS (Space Transportation System) Resident Office at North Vandenberg as a point of contact with the Air Force for base support of KSC elements and for range support of all NASA STS payloads,

automated spacecraft and KSC expendable vehicles requirements. In addition, a number of engineers with extensive shuttle experience at KSC have been assigned directly to the Air Force to assist that agency's activation of its shuttle facilities.

The Air Force will also join NASA in a procurement effort which will eventually lead to selection of a contractor for the processing of the Space Shuttle at both KSC and Vandenberg. The contract will result in significant cost savings during the shuttle operational era.

At Kennedy, the topography is table-top flat and terrain uses are limited principally by marshes and subtropical lagoons. Distances between processing and launch facilities are relatively short. At Vandenberg, the terrain is marked by rugged hills, canyons and plateaus with the northern and southern portions of the base separated by the flood plain of the Santa Ynez River. And distances between facilities are much greater.

Orbiter operations will be centered at North Vandenberg where the existing, 8,000-foot-long airfield has been extended. The orbiter will land on a runway 15,000-foot-long, 200-foot wide, and be safed, serviced and processed in nearby facilities. Orbiter checkout will be accomplished in this area, supported by a highly automated Launch Processing System identical to that at KSC. Also located in this area are astronaut quarters, originally built for the MOL program. An Orbiter Lifting Frame similar in function to the Mate/Demate Device used at KSC is located at the airfield to load and unload orbiters on and off the 747 Shuttle Carrier Aircraft for ferry operations.

Launch activities are located 16 miles to the south at former MOL Space Launch Complex 6, nestled in a network of hills overlooking Point Arguello. The orbiter will be towed the 16 miles to SLC-6 on a special transporter. Of the 16-mile route, about two miles will require new construction and one mile goes down the six percent grade from North Vandenberg to the Santa Ynez flood plain before winding up into the hills to the launch site in South Vandenberg.

The shuttle's huge external tanks will be transported from their fabrication site in Louisiana by an ocean-going barge capable of carrying four tanks simultaneously via the Gulf of Mexico and Panama Canal to a dock at the southernmost point of Vandenberg. The tank will then be towed two miles on transporters to a new ET Checkout and Storage Facility about a mile from the launch pad.

At KSC, the shuttle elements are erected atop a Mobile Launcher Platform in the 52-story-tall Vehicle Assembly Building at Complex 39 and moved by a gigantic transporter to a launch pad on the rim of the Atlantic Ocean for final checkout and launch.

At Vandenberg, shuttle elements will be assembled on a launch mount at SLC-6. First the two solid rocket boosters will be erected on the mount using a crane on the 275-foot-tall Mobile Service Tower (MST) on the eastern side of the pad.

Once the boosters are stacked, a 25-story-tall building—the Shuttle Assembly Building (SAB)—is rolled up to the Mobile Service Tower to form an enclosed area in which the external tank and orbiter can be mated with the boosters. Conducting the external tank/orbiter mating in the protected environment formed by the SAB/MST combination permits these critical operations to be accomplished using proven KSC equipment and procedures which greatly enhance personnel and flight hardware safety.

A door in the west end of the SAB allows the Payload Changeout Room (a 170-foot-tall mobile building) to roll up to the mated orbiter and install a payload.

During final processing, the Payload Changeout Room and Mobile Service Tower will remain in position around the stacked vehicle for access and checkout until the final phase of the launch countdown. At that time, they are moved to their "parked for launch" position, the vehicle is fueled, the crew enters the orbiter, and the terminal count begins.

The Launch Control Center is located in the Control Center built for the MOL programs. Its layout is similar to control facilities at KSC and the majority of equipment is common to both launch sites, including the Launch Processing System originally developed for KSC.

As at KSC, there are two modes of inserting orbiter cargo. Large payloads such as Spacelab can be loaded into the orbiter horizontally at the Orbiter Maintenance and Checkout Facility near the airfield on North Vandenberg. Other payloads can be located into the orbiter vertically at the pad using the Payload Ground Handling Mechanism of the mobile Payload Changeout Room. Primary processing of vertically loaded cargo is accomplished in the Payload Preparation Room, a large structure on the extreme western rim of SLC-6.

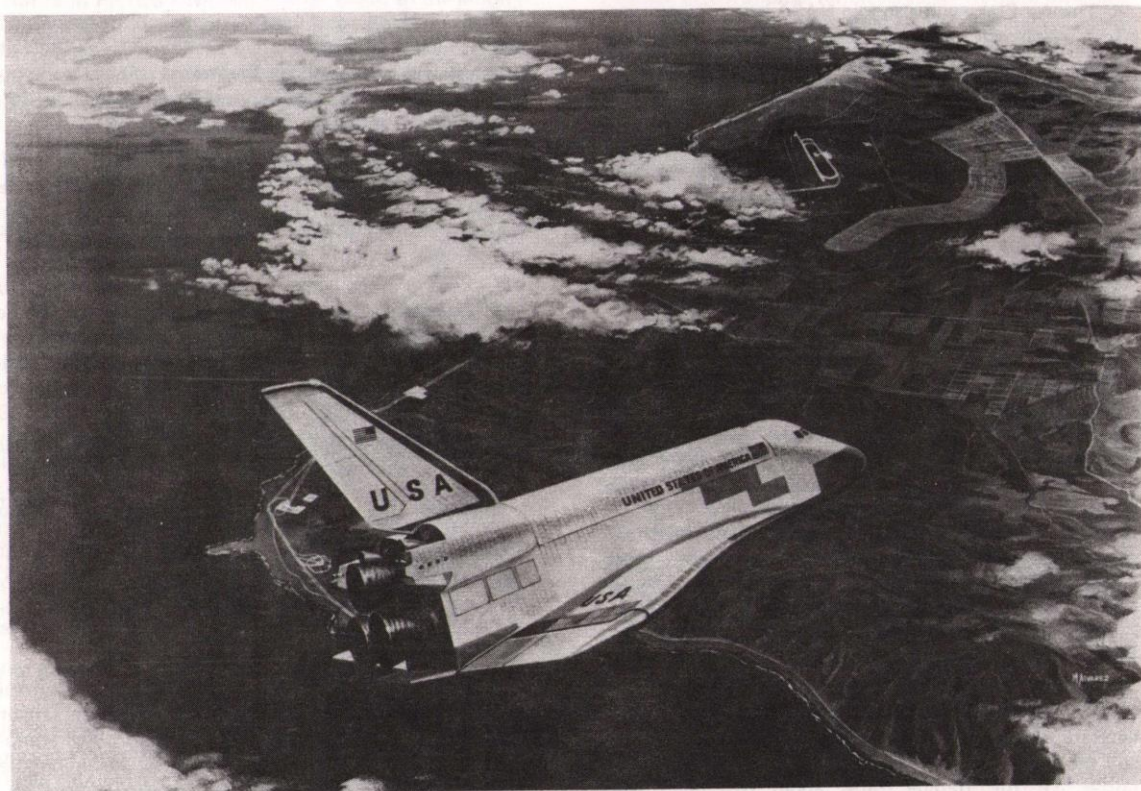
The solid rocket boosters will be jettisoned approximately two minutes after liftoff and impact in the

Pacific Ocean approximately 185 miles south of Vandenberg and west-southwest of Los Angeles. The expendable casings, conical forward structures and parachutes will be recovered by a powered barge (and other vessels as needed) and returned to Port Hueneme, a large Naval base 85 miles southeast of Vandenberg for appropriate processing.

With activation of the Vandenberg shuttle facilities and the polar or high inclination orbit access they will permit, Space Shuttle operations will begin to realize their full potential. The Space Shuttle fleet of two

orbiters—Columbia and Challenger will be expanded by at least two more—Discovery and Atlantis—and payloads will begin soaring into space from both the east and west coasts. The launch rate from the west coast facility's single pad is expected to reach less than half that of KSC, which will have two operational launch pads.

The fleet of orbiters will be flying routinely to and from space, ferrying into orbit commercial, scientific and national security payloads. The shuttle has given us a head start in the commercialization, utilization and exploration of space.



Artist's concept of Shuttle Landing at VAFB

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The Kennedy Space Center does not maintain a full-time public information function at Vandenberg AFB and any inquiries concerning NASA operations there should be made to the Public Information Office, Mail Code PA-PIB, John F. Kennedy Space Center, NASA, Kennedy Space Center, FL 32899.