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PROJECT: ATLAS-CENTAUR 6 (AC-6)

SCHEDULED LAUNCH:

CONTENTS

(Scheduled to be launched no earlier than Aug.4)

NEWS NASA
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FOR RELEASE: FRIDAY PM'S
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CENTAUR (AC-6)
TEST FLIGHT
SCHEDULED AUG. 4

The hydrogen-fueled Centaur launch vehicle will be test-flown from Cape Kennedy, Fla., by the National Aeronautics and Space Administration no earlier than Aug. 4.

The vehicle development flight, designated Atlas-Centaur 6 (AC-6), will be a full-scale simulated mission to determine Centaur's capability to inject a Surveyor spacecraft on a lunar-transfer trajectory.

Surveyor is being developed by NASA to soft-land on the Moon and conduct lunar surface studies in support of future manned Apollo missions.

The AC-6 mission, sixth in a series of eight scheduled Centaur development flights, will be a further step in qualifying the Centaur vehicle for operational lunar and planetary space missions. The flight is designed to obtain data on several new Atlas-Centaur features and to continue evaluation of other components and systems tested during previous missions.

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The AC-6 vehicle will be flown along a simulated lunar transfer trajectory. Full lunar transfer energy for this mission is a velocity of about 34,000 feet-per-second, or 23,700 miles-per-hour at spacecraft separation.

Following separation from Centaur, the Surveyor model will continue on a highly elliptical Earth orbit with an apogee of about 515,000 miles and a perigee of 100 miles. An orbit will be completed about every 32 days.

AC-6 will test several new development features of the Centaur vehicle, including a Centaur propellant utilization system to provide maximum use of available propellants; an up-rated Atlas propulsion system--used on other Atlas launches but not with Centaur--which develops about 389,000 pounds of booster thrust; and a smaller volume liquid oxygen tank in the Centaur stage which matches the volume of the liquid hydrogen tank more accurately than earlier vehicles and thus provides more payload capability.

Centaur's guidance loop will be "closed" for the AC-6 flight; guidance steering signals will be utilized for vehicle steering. The guidance system, located on the Centaur stage, will generate pitch and yaw steering signals to the autopilots for flight control from booster engine cutoff (BECO) plus eight seconds to termination of the Centaur retro-maneuver.

Another area of major interest on AC-6 is Centaur's launch-on-time capability. Since future engineering and scientific Surveyor spacecraft will be launched toward the Moon on one-burn, direct ascent missions, only certain periods, or "launch windows," are available. This is a period during which a vehicle must be launched from Earth to intercept a body in space.

For AC-6, a six-day period has been selected closely approximating the period a Surveyor would be launched with a prime objective of landing on the Moon. The only real difference between the simulated AC-6 mission and an actual Surveyor mission is that the latter would take place about six hours earlier to obtain daylight photo coverage at launch.

Centaur, employing liquid hydrogen and liquid oxygen, is being developed as a high-energy second-stage vehicle This propellant combination provides about 35 per cent more energy than vehicles using conventional fuels. In addition to its mission of launching Surveyor toward the Moon, the Centaur upper stage will be combined with a Saturn 1B vehicle for other planetary space missions.

Centaur is being developed for NASA's Office of Space Science and Applications under technical direction of NASA's Lewis Research Center in Cleveland. Centaur launches are conducted for Lewis by NASA's Goddard Space Flight Center's (Greenbelt, Md.) Launch Operations at Cape Kennedy.

Centaur and its Atlas booster are built for NASA by Convair Division of General Dynamics, San Diego, Calif. The second stage hydrogen-oxygen engines are provided by Pratt and Whitney Aircraft Division of United Aircraft Corp., West Palm Beach, Fla., under technical direction of NASA's Marshall Space Flight Center, Huntsville, Ala. which used the same engine in the second stage of the Saturn I vehicle. Honeywell Inc., St. Petersburg, Fla., provides Centaur's all-inertial guidance system. More than 300 other contractors throughout the U.S. are contributing to the project.

(END OF GENERAL NEWS RELEASE - BACKGROUND INFORMATION FOLLOWS)

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TECHNICAL BACKGROUND AND FLIGHT HISTORY

AC-6 is the sixth of eight scheduled engineering development flights to qualify the Centaur vehicle for operational space missions. Once operational, Centaur's primary mission will be to place the instrumented Surveyor spacecraft on the Moon and conduct surface studies.

The Centaur vehicle accomplished the first known successful flight of a vehicle using liquid hydrogen as propellant Nov. 27, 1963. Liquid hydrogen also has been tested successfully in the Saturn I vehicle. Saturn V will use hydrogen engines to propel American astronauts to the Moon. Liquid hydrogen also is used in NERVA -- Nuclear Engine for Rocket Vehicle Applications -- the joint NASA-Atomic Energy Commission program to develop nuclear rocket technology.

Since the initial flight success of Centaur, three development test vehicles have been launched: June 30 and Dec. 11, 1964, and March 2, 1965.

The June 30 mission accomplished five of six primary objectives. A premature shutdown of the second stage hydrogen engines resulted in a shorter-than-planned burning period.

The December 11 flight successfully accomplished all primary objectives. These included the first use of Centaur's inertial guidance system to perform several in-flight maneuvers in addition to steering the Atlas-Centaur vehicle.

An attempt last March 2 to test the Centaur with a dummy Surveyor model on a simulated lunar trajectory--similar to the objectives of the upcoming AC-6 mission--failed when the Atlas-Centaur vehicle settled back on its launch pad shortly after liftoff and burned, resulting in destruction of the vehicle and damage to Launch Complex 36-A.

Centaur project officials traced the March 2 failure to a fuel valve in the Atlas booster which closed after liftoff, shutting down the flow of propellants to the Atlas booster engines and subsequently terminating thrust. Although this problem had never occurred during more than 200 NASA and Air Force Atlas launches, the fuel valve has been redesigned.

A second Centaur launch complex--36-B--about 90 per cent complete when 36-A was damaged, has been completed to support the AC-6 development engineering mission. Both launch pads use a common blockhouse, which was not damaged during the March 2 mission.

During the past two and one-half years, the Centaur vehicle has undergone one of the most rigorous ground-testing programs of any U.S. rocket. Both the Atlas booster and Centaur second stage and their associated systems and sub-systems have been subjected to a series of ground tests to determine how the vehicle reacts during actual flight.

These include vibration and load tests with a full-scale Atlas-Centaur/Surveyor structural model combination; separation tests of the Atlas-Centaur; insulation panel and nose fairing jettison and heat tests; ground-chill tests of the hydrogen engines; high-speed rocket sled tests of the guidance system; and other tests.

A full-scale Centaur stage is now mounted in a Space Power Chamber at NASA's Lewis Research Center in Cleveland. This vacuum facility, previously used for testing of full-scale aircraft and their propulsion systems, as well as for Project Mercury spacecraft tests, is capable of simulating space conditions at an altitude of 100 miles. It permits complete Centaur systems testing up to engine ignition.

A new ground-test facility, called a Combined Systems Test Stand, was built for NASA by Convair in San Diego, Calif. This facility, now being used to test the AC-7 vehicle, permits complete pre-launch ground tests of Atlas-Centaur and Surveyor prior to shipment to Cape Kennedy, this eliminating many similar tests currently required after the vehicle is erected for launch.

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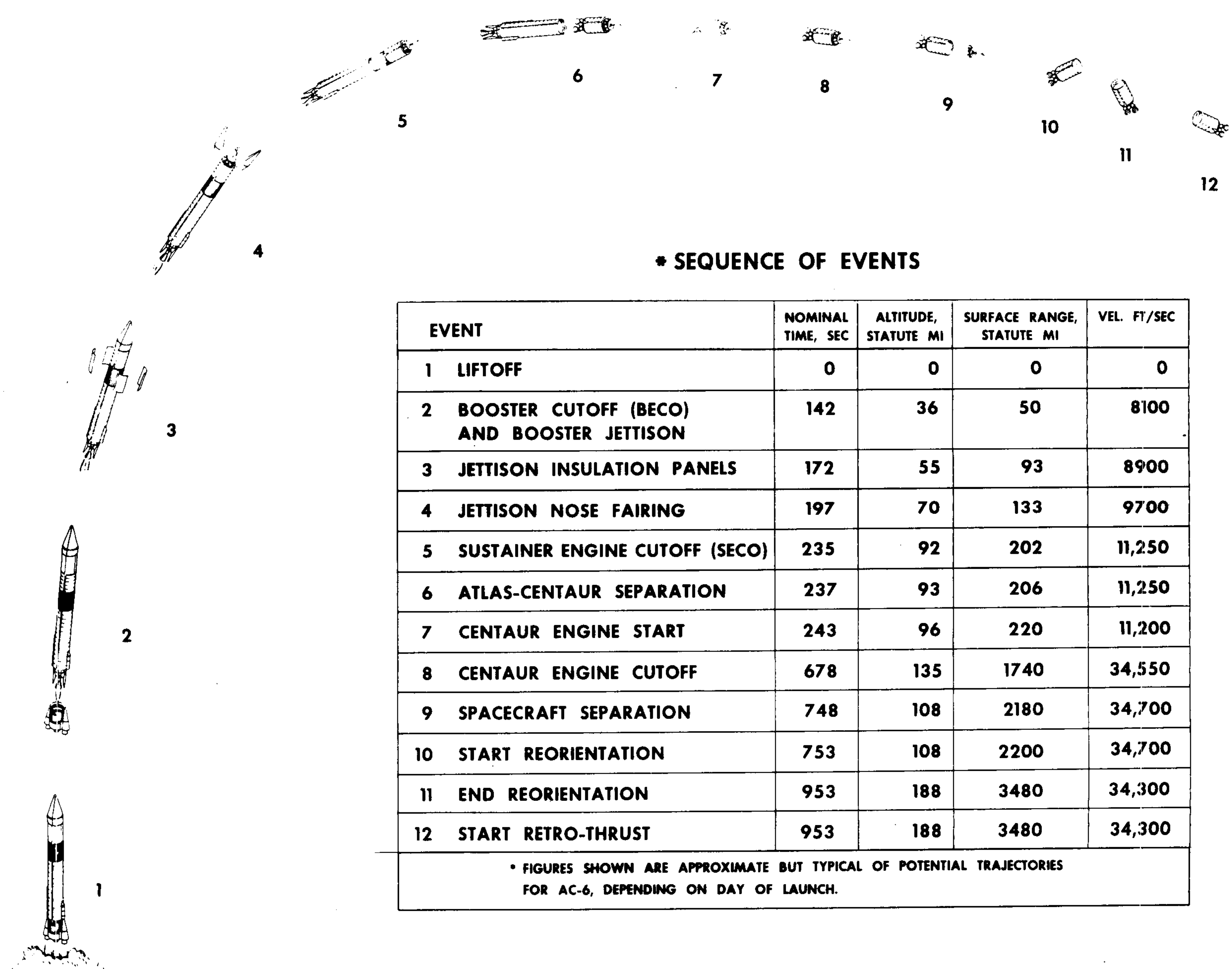
ATLAS-CENTAUR 6



* SEQUENCE OF EVENTS

EVENT	NOMINAL TIME, SEC	ALTITUDE, STATUTE MI	SURFACE RANGE, STATUTE MI	VEL. FT/SEC
1 LIFTOFF	0	0	0	0
2 BOOSTER CUTOFF (BECO) AND BOOSTER JETTISON	142	36	50	8100
3 JETTISON INSULATION PANELS	172	55	93	8900
4 JETTISON NOSE FAIRING	197	70	133	9700
5 SUSTAINER ENGINE CUTOFF (SECO)	235	92	202	11,250
6 ATLAS-CENTAUR SEPARATION	237	93	206	11,250
7 CENTAUR ENGINE START	243	96	220	11,200
8 CENTAUR ENGINE CUTOFF	678	135	1740	34,550
9 SPACECRAFT SEPARATION	748	108	2180	34,700
10 START REORIENTATION	753	108	2200	34,700
11 END REORIENTATION	953	188	3480	34,300
12 START RETRO-THRUST	953	188	3480	34,300

* FIGURES SHOWN ARE APPROXIMATE BUT TYPICAL OF POTENTIAL TRAJECTORIES FOR AC-6, DEPENDING ON DAY OF LAUNCH.

LAUNCH VEHICLE

Total liftoff weight: 303,000 pounds

Total liftoff height: 113 feet

	Atlas-D Booster	Centaur Stage
Weight	263,000 pounds	40,000 pounds
Height	75 feet (including interstage adapter)	48 feet (with nose fairing)
Thrust	389,000 pounds at sea level	30,000 pounds at altitude
Propellants	Liquid oxygen and RP-1, a kerosene-like fuel	Liquid hydrogen and liquid oxygen
Propulsion	MA-5 system, built by Rocketdyne Div., North American Aviation, Inc.	Two RL-10 engines by Pratt and Whitney Aircraft Div., United Aircraft Corp.
Speed	5500 mph at BECO, 7,700 mph at SECO	23,700 mph at injection
Guidance	Pre-programmed auto-pilot through BECO	Honeywell Inc. all inertial
Contractor	GD/Convair	GD/Convair

AC-6 consists of a modified Series D Atlas booster combined with a Centaur second stage. Both stages are 10 feet in diameter, connected by an interstage adapter. There are no internal braces in Atlas or Centaur; both maintain their rigidity through pressurization.

The Atlas first stage, 75 feet in length including the interstage adapter, is referred to as a one and one-half stage configuration since the booster engines are jettisoned after use. Atlas employs conventional kerosene as a propellant and liquid oxygen as the oxidizer.

Using an MA-5 propulsion system, built by Rocketdyne Division of North American Aviation, Inc., Atlas develops about 389,000 pounds of thrust. For the AC-6 mission, Atlas will be equipped with uprated booster engines developing about 165,000 pounds of thrust each, a sustainer engine with 57,000 pounds and two vernier engines developing 1,000 pounds each.

Following first stage flight, the Atlas and Centaur are separated by a flexible linear-shaped charge which severs the interstage adapter. Eight retro-rockets mounted on the aft end of Atlas are fired to increase the separation rate.

The Centaur upper stage, 48 feet long including the nose fairing, is a space vehicle powered by two high-energy Pratt and Whitney RL-10 engines rated at 15,000 pounds of thrust each. Centaur's tank is constructed of Type 301 stainless steel, the same material used for the Atlas tanks. Payload, guidance and electronic equipment packages are mounted on the forward bulkhead of Centaur's hydrogen tank.

To minimize the boiloff of liquid hydrogen, which is maintained at -423 F. degrees, external thermal insulation fiberglass panels are mounted on the hydrogen tank. The four panels weigh about 1,250 pounds and are jettisoned after the vehicle leaves the Earth's atmosphere.

AC-6 will be the first mission to test fully the Propellant Utilization System. The system will be flown closed-loop: i.e., it will determine proper utilization of liquid hydrogen and liquid oxygen to insure that Centaur uses all available propellants, thus attaining maximum energy necessary to inject a payload on an intercept trajectory with the Moon.

A nose fairing, constructed of honeycombed fiberglass, surrounds the payload and equipment mounted on Centaur and provides thermal and aerodynamic protection during flight through the atmosphere. The nose fairing weighs about 2,000 pounds and is jettisoned shortly after the insulation panels.

The Centaur stage of the AC-6 vehicle will be equipped with a smaller-volume liquid oxygen tank to achieve greater payload capability.

Centaur's high-energy propulsion system has been designed with a re-start capability: i.e., the vehicle and its payload can be flown into a low Earth orbit, coast until its target is in a favorable position, then restart its engines and achieve a lunar or escape trajectory. Although current Surveyor spacecraft will be launched toward the Moon on a single-burn, direct ascent trajectory, Centaur's multiple short capability will be tested during later Centaur development missions.

PAYLOAD CONFIGURATION

The dummy payload for AC-6 is a Surveyor dynamic model designed to simulate the dynamic-response characteristics of the Surveyor spacecraft.

The model consists of a spaceframe supplied by Hughes Aircraft Co., El Segundo, Calif., contractor to NASA's Jet Propulsion Laboratory at Pasadena for the Surveyor project, and a retromotor simulator assembly built by General Dynamics/ Convair.

The spaceframe is similar to that of a real Surveyor spacecraft, except for certain reinforcing structures which are deleted. Dummy masses are mounted on the spaceframe to simulate the mass properties of those items they replace.

The simulated planar antenna, solar panel and mast assembly are similar in appearance to their Surveyor counterparts, but are not operational. A simulated Surveyor landing gear is incorporated.

Mounted on a mast above the spaceframe is an omnidirectional antenna, which is used with the S-band transponder. The transponder is required for post-separation tracking by the Deep Space Network.

The dynamic model is instrumented with temperature sensors, accelerometers, microphones, position potentiometers and strain gages, all designed to monitor its behavior during the Atlas-Centaur boost phase.

The S-band transponder on the dynamic model permits ground tracking following separation from Centaur. The transponder power supply is designed for 20 hours of operation.

The purpose of the retromotor simulator is to simulate the Surveyor retrorocket engine, which will later be used to decelerate operational spacecraft for landing on the Moon.

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The dummy retromotor simulates the mass, moment of inertia and center of gravity of the Surveyor retromotor and also carries the telecommunications system.

The dummy retromotor is mounted on the spaceframe in much the same manner in which the actual Surveyor retro-rocket will be attached to Surveyor. However, since it does not have to be separated from the spacecraft, as in the case of Surveyor, the assembly is attached with non-explosive bolts.

The dynamic model weighs about 2,100 pounds. Actual Surveyor spacecraft will weigh approximately 2,250 pounds.

INSTRUMENTATION AND TRACKING

AC-6 will be heavily instrumented. The telemetry will radio data measurements from Centaur for about three and one-half hours, or until its battery power is depleted.

Measurements on the upper stage will send information on engine performance, guidance system and autopilot operation, and structural behavior. Booster stage measurements relate primarily to engine function and guidance systems, plus standard vibration, bending and temperature data.

A number of measurements will be made on the Surveyor dynamic model, with particular emphasis on aerodynamic heating effects during boost flight and separation of the spacecraft from Centaur.

AC-6 will be tracked during powered flight and portions of its orbital flight to obtain performance information.

Atlas-Centaur power flight tracking down the Eastern Test Range will be accomplished by C-band radar and Azusa Mark II/Glotrac systems by stations at Cape Kennedy, Antigua, Grand Bahama, San Salvador and Bermuda.

Separation, reorientation and retromaneuver data will be received downrange by Air Force Eastern Test Range (AFETR) ground stations extending from Cape Kennedy to Pretoria, South Africa, and two telemetry ships on station in the South Atlantic.

Following injection into orbit, an S-band transponder attached to the Surveyor model will be tracked by stations of the Deep Space Network until depletion of its battery power, estimated at about 20 hours.

A C-band transponder on the Centaur stage will be tracked by Air Force Eastern Test Range radar tracking stations for at least 3 and one half hours after liftoff.

MISSION DESCRIPTION

Liftoff. For the first two seconds the Atlas-Centaur vehicle rises vertically, then for thirteen seconds rolls from a fixed launcher heading of 115 degrees to the desired flight plane azimuth of from 93 degrees to 111 degrees depending upon launch time.

T plus 15 seconds. The vehicle begins pitching over to the programmed flight trajectory. This gradual pitchover continues throughout the Atlas-powered phase of the flight.

T plus 142 seconds. Booster engine cutoff (BECO) by a signal issued by Centaur guidance when an acceleration level of 5.7 G's is sensed. This is followed by jettisoning of the booster package 3.1 seconds later. The sustainer engine continues to propel the vehicle.

T plus 172 seconds. The four fiberglass insulation panels surrounding the Centaur stage are jettisoned.

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T plus 197 seconds. The fiberglass nose fairing which protects the payload during flight through the atmosphere is jettisoned.

T plus 235 seconds. The Atlas Sustainer Engine Cutoff (SECO) occurs at fuel depletion at an altitude of about 90 miles.

T plus 237 seconds. Following SECO,Atlas and Centaur are separated. Eight retrorockets mounted on the aft end of Atlas increase the rate of separation.

T plus 243 seconds. Centaur hydrogen engines are ignited for a planned burn of 435 seconds. Second state ignition occurs at an altitude of about 95 miles. During Centaur's powered flight, the vehicle's propellant utilization system will be flown closed loop: i.e., the system will determine proper distribution utilization of available liquid hydrogen and liquid oxygen to insure that Centaur uses all propellants, thus obtaining maximum energy necessary to inject a payload on an intercept trajectory with the Moon. AC-6 will be the first mission to full-test the system.

T plus 678 seconds. Second stage ignition terminates.

T plus 748 seconds. The Surveyor model will be separated from Centaur by firing three squibs which release latches on the payload adapter. Three spring-loaded cylinders then force the Centaur and model apart. Separation occurs at a velocity of 34,700 ft. per second or 23,700 mph.

T plus 753 seconds. Since future Surveyor operational spacecraft will be oriented with respect to the Sun and the star Canopus, the Centaur vehicle must be separated sufficiently from the spacecraft to preclude Surveyor's star seeker from locking onto the launch vehicle erroneously. This will be accomplished by:

1. Rotating Centaur 180 degrees by its attitude control system.

2. Blowing residual propellants through Centaur's engines to apply retro-thrust. This "retromaneuver" lasts about 15 minutes.

The successful execution of the retromaneuver will separate Centaur and the dynamic model sufficiently. However, the dynamic model being flown on AC-6 will not be equipped with a star seeker, nor will it have any mid-course maneuver capability as will future Surveyors.

Following separation, the dynamic model will continue in its elliptical orbit around Earth. The Centaur vehicle also will circle Earth, but in a shorter orbit than the model.

CENTAUR DEVELOPMENT TEAM

The Centaur program is directed in NASA Headquarters by the Office of Space Science and Applications. Dr. Homer Newell is Associate Administrator for Space Science and Applications. Vincent L. Johnson is Director, Launch Vehicle and Propulsion Programs. R.D. Ginter is Centaur Program Manager.

Project management is assigned to NASA's Lewis Research Center. Dr. Abe Silverstein is Director of Lewis. Bruce T. Lundin is Associate Director for Development. David S. Gabriel is Centaur Project Manager.

Centaur launches are conducted for Lewis by Goddard Space Flight Center's Launch Operations, Cape Kennedy. Robert Gray is Chief, GSFC Launch Operations.

Convair Division of General Dynamics Corp. is prime contractor for the Centaur vehicle, including the Atlas booster. Grant L. Hansen is Centaur Program Director and Vice President, GD/Convair.

Pratt and Whitney is an associate prime contractor for Centaur's RL-10 hydrogen engines. Gordon Titcomb is P&W's RL-10 Project Manager.

Honeywell, Inc., St. Petersburg, Fla., is an associate prime contractor for Centaur's inertial guidance system. R.B. Foster is Program Manager.

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