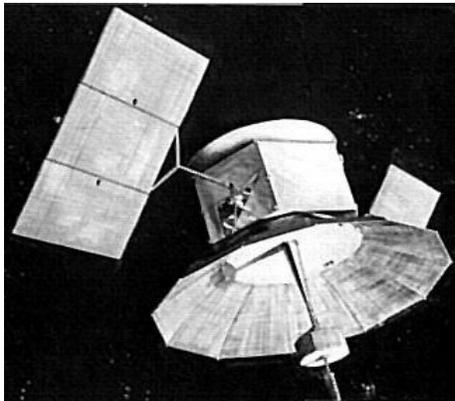




Atlas Centaur-67: Go or No Go for Launch?

Since 1968, NASA has flown dozens of scientific, defense, and commercial payloads into space on the *Atlas Centaur* rocket. On March 27, 1987, *Atlas Centaur Mission 67 (AC-67)* is sitting on a launch pad at Cape Canaveral, Florida, waiting to carry the U.S. Department of Defense Fleet Satellite Communications (*FLTSATCOM*) F-6 spacecraft into orbit.

FLTSATCOM is a constellation of military satellites that serve as a global, ultra-high frequency (UHF) link among U.S. Navy aircraft, ships, submarines, and ground stations. A high-capacity spaceborne communications system, it provides shore-to-fleet and single-way communications. It is also used for high-priority communications with the U.S. Air Force Strategic Airlift Command aircraft, the E-3A airborne warning and control system (AWACS), and the presidential command structure. Four operational satellites positioned around the globe in near-equatorial geosynchronous orbits, as well as a fifth, on-station spare spacecraft, make up the *FLTSATCOM* system.



*Figure 1 - FLTSATCOM Satellite in Orbit.
NASA image*

The *Atlas Centaur* is an expendable launch vehicle (ELV) used by NASA to place the *FLTSATCOM* spacecraft into geostationary transfer orbit (GTO). An apogee kick motor is employed to achieve the final mission orbit.

Launch Day: Black Clouds

On the scheduled launch day for *AC-67*, the weather does not look promising. Thunderstorms are building throughout central Florida not far from the launch site. As on every launch, the launch team includes weather and safety officers responsible for ensuring that all launch weather and safety criteria are met before final ignition and lift-off.

The launch director, launch team members, management advisors, and spectators are gathered in the Mission Directors' Center (MDC). In the team environment, amidst the flurry of launch-preparation activity, it is not entirely clear who is an authority and who is an advisor. In addition, some of the two-way radios are not providing clear communications between the blockhouse and Kennedy Space Center. Messages have to be repeated for clarity, further adding to the confusion in the launch center.

At T-30, there are concerns about the weather. Balloons released to collect wind data at higher altitudes have been breaking, failing to reach sufficient altitude. One balloon remains in the air, but even if the necessary data is collected, it will need to be sent to San Diego for analysis and then uploaded to the guidance system. A delay is looking more likely.

As launch countdown proceeds the wind profile is eventually uploaded in time, but a squall line develops, producing thunderstorms in areas adjacent to the launch facility. The clouds and the deteriorating weather conditions are apparent to the launch team at the site as they review the launch commit criteria¹. One launch item sticks out stating:

"The flight path of the vehicle should not be through middle-level cloud layers 6,000 feet or greater in depth, when the freezing level is in the clouds."

A debate ensues in the launch center over the meaning of this particular weather criteria, with some questioning the reason for the specific cloud layer temperatures. It does not look like a serious hazard, particularly in the context of NASA's *Atlas Centaur* track record. Over the previous two decades, the agency had successfully launched more than 60 *Atlas Centaurs*. Many members of the launch team feel that there is ample

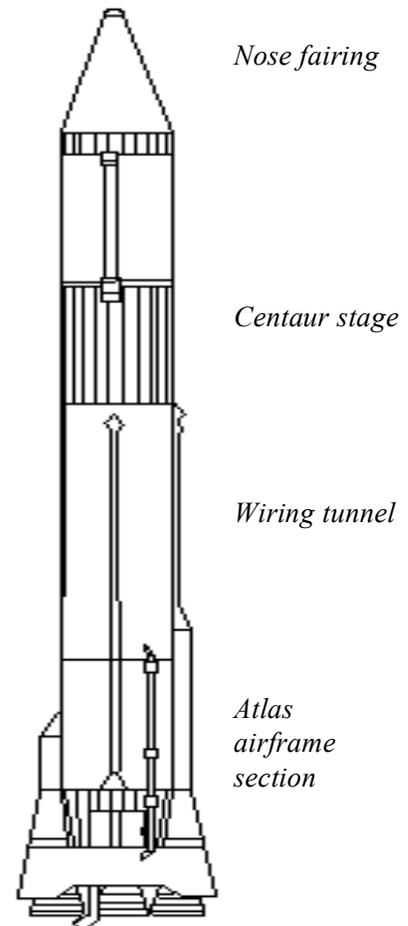


Figure 2 - Typical Atlas Centaur configuration. NASA image

¹ Launch Commit Criteria are established well in advance of the launch and are inviolate conditions that must be met before the launch can proceed. The idea is not to entertain discussion of critical limits during the launch itself when there may be undue pressure to proceed.

experience in the room to make a launch decision. And on the Air Force side, the payload team is eager to use an available launch window for its \$83 million spacecraft.

At the same time, there is a sidebar discussion of the weather criteria centered on vehicle icing concerns. One member of the team contacts a nearby U.S. Federal Aviation Administration (FAA) control center to gain insight from any aviation activity in the cloud cover. The FAA reports two recent flights through the relevant cloud layers with no icing incidents noted.

This information is reassuring to the launch team members preoccupied by icing concerns—icing appears not to be a risk. And the presence of clouds is not, in itself, a reason to halt the countdown. The team agrees to call the weather office for a final weather “go,” just before launch.

T-6: “This is Atlas-Centaur launch control.. We got an assist from a T-38 aircraft landing at the Shuttle Flight Facility. The pilot reported no icing as he descended through the clouds..That would be a constraint if there were icing conditions within those clouds and that is consistent with the earlier data that there is none. There is an area of rain that has moved into the area. However, lightning activity is about 25 miles downrange and about 10 miles north of the Cape so we are acceptable at launch complex 36. ... As long as there is no thunderstorm activity within five nautical miles of the vehicle’s flight path we would have an acceptable launch condition. Also, we cannot have lightning within five nautical miles of the launch complex at liftoff time.

T-5 and holding

Cape forecaster reporting no cloud or ground lightning within the last ten minutes. Forecaster is recommending to launch director that we pick up the count. [picking up countdown at 4:17]

T-5 and counting: “This would bring us to a liftoff at 4:22 should the Cape weather office not advise that we have a constraint due to lightning activity within five miles of the pad or the vehicle’s projected flight path....

Cape weather advising Launch Director... that there is some lightning potential within the area of the Shuttle Landing facility, however that is outside the five nautical miles constraint.” ...

T-3: “Cape weather advising [Launch Director] that they recommend we proceed.”²

² Transcript of the Atlas Centaur Launch Control Video & Commentary.