Lightning Strikes Twice at NASA

It was no bolt from the blue that destroyed the Atlas-Centaur in March, but a well-studied meteorological phenomenon

On Mosquito Lagoon, close to the Kennedy Space Center in Florida, about 45 scientists gather each summer to watch the thunderclouds and reenact Benjamin Franklin's famous experiment with a kite and a key—but today they use rockets and computers.

What they know about lightning could have prevented the accident that occurred nearby on 26 March when the National Aeronautics and Space Administration (NASA) sent an Atlas-Centaur to its destruction. But, as a NASA investigator revealed last week, the experts and the operational chiefs failed to get together.

Jon Busse, chairman of NASA's inquiry into the accident, disclosed at a press conference on 11 May that the Atlas-Centaur, carrying a Navy communications satellite, was launched in a heavily charged electrical atmosphere on 26 March. The rocket itself triggered a lightning bolt. A single bolt punched through the fiberglass nose cone, spread fingers of electricity around the computerized brain that commands the motors, and changed one word of program language. As a result, the motors sent the rocket veering off course 51 seconds after lift-off, at the moment of peak strain. The $160-million package began to break up, and flight controllers had no choice but to deliver the coup de grace.

The risk that this might happen should have been noted in advance for several reasons. Lightning struck the Apollo 12 command module on lift-off 18 years ago, nearly aborting a trip to the moon. As a result, shuttle launch criteria now forbid launching in electrical storms. If these criteria had been applied, they would have prevented the launch of the unmanned Atlas-Centaur this spring. According to one researcher, NASA has installed the "most sophisticated lightning monitoring system in the world" around the Kennedy Space Center. But its data were not used.

Busse said that information on the electrical hazard was ready at hand on 26 March, but that weather watchers—in this case, the Air Force—gave approval for the launch anyway. There was a failure of communication, Busse said, and a failure at NASA to "exercise awareness, judgment, and leadership."

NASA opted out of weather forecasting at Cape Canaveral in 1980 to avoid duplicating the Air Force's work and to save money for the shuttle program. But the agency has been well aware of lightning hazards for years, and the risks are pretty well understood because of ongoing research.

The modern-day Franklins on Mosquito Lagoon participate in something called the "rocket triggered lightning program." NASA is one of half a dozen sponsors. Fittingly, the work was started and is still supplied by France. (In his autobiography, Franklin praises the French for being the first to recognize the importance of his kite experiment.)

Rather than kites, researchers now use small, 3-foot rockets. Each one pulls a 2100-foot wire toward the thunderclouds. The lower end of the wire attaches not to a key but to a cylinder filled with electronic and optical gear. When lightning hits, it scorches down the wire, vaporizes it, and creates data in the cylinder for NASA to study all winter long. The experiment is repeated scores of times each summer.

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One scientist says, "NASA is launching rockets on one side of the Cape betting they will be hit by lightning and it's launching them on the other betting they won't." The second bet is a bad one, as everyone knows now. But it should have been obvious before.

According to Busse, one monitoring device 1.5 miles from the launchpad registered a charge of 8000 volts per meter. Manned flights are not supposed to go aloft through heavy clouds when there is a pattern of high electrical hazard, generally understood to be a charge of plus or minus 1000 volts. About 30 meters scattered around the site give continuous readings, but one local scientist reports that the system may have been disregarded this spring for two reasons. First, the official launch criteria for unmanned rockets do not require that electrical readings be checked. Second, because no manned launches are scheduled at the moment, the meter system may not have been calibrated recently. When the high readings appeared at launch time, it was easy to dismiss them as irrelevant.

In addition to watching the clouds at Cape Canaveral, NASA has concluded an extensive program of lightning research at its Langley research center in Hampton, Virginia. For six summers, a group led by Bruce Fisher flew a weather-hardened fighter plane (the F-106) into thunderclouds to induce lightning. The plane was hit more than 650 times, according to one participant. Most of the strikes were caused by the airplane itself. The researchers also found that plastics and composites on the surface of the plane can be vaporized by lightning and that electronics on the inside are vulnerable to interference. Fortunately for them, the F-106, a "flying tank," as one called it, has an all-metal exterior and relies on hydraulic rather than electronic controls.

The Atlas-Centaur that went down in March was particularly vulnerable to lightning, Busse said, because it was not shielded against electrical interference.

Busse's report is unfinished and is not expected for another 2 months. Busse listed the chief recommendations at the press conference, however. NASA launch officials will be asked to adopt a "questioning and challenging attitude" about the validity of data they are given. More training will be recommended, with a stress on accurate communication between the decision makers and the support crew. The launch criteria for unmanned rockets should be changed, Busse said, so that they will be roughly the same as those for the shuttle. It may not be practical to escape all lightning hazards. NASA will avoid launching into clouds if ground meters indicate the presence of a 1000-volt charge within 5 miles of the pad. These standards will be refined as new research data are incorporated into the launch routine. Finally, the report will recommend that the electrical hardening of unmanned rockets be improved. ■ **ELIOT MARSHALL**