

NASA Officials Were Apprehensive About Possibility of a Computer Lapse

By ANDREW POLLACK

The possibility of an error in the space shuttle's computer programs had long been a fear of both NASA officials and independent scientists. Such an error apparently cropped up yesterday, and the shuttle's launching was delayed for at least two days.

The programs aboard the shuttle contain roughly 500,000 lines of instructions that tell the five onboard computers not only how to run the spacecraft but also how to coordinate with one another. Each line, in computer language, is a series of zeroes and ones.

"Any one of those ones and zeros that's wrong is a potential mission killer," said one expert familiar with the shuttle's computer systems.

The National Aeronautics and Space Administration and its contractors went to extraordinary lengths to test and retest the software and insisted that the possibility of an error was extremely remote. But others have criticized their efforts in the past. The software is the set of instructions, the programs, that the computer machinery, known as the hardware, executes to perform its tasks.

A review panel, part of a wider investigation of the total shuttle program, reported last year that NASA was not paying enough attention to some aspects of software reliability. Committee members said, however, that the agency had since acted to correct the problems.

Other experts say that the whole computer system is outdated and relies too

heavily on the software's being flawless.

"I was just appalled at the amount of work involved in using that synchronization," said John F. Meyer, professor of electrical and computer engineering at the University of Michigan. "God knows if they found everything."

The importance of the computer programs stems from the fact that the computers aboard the spacecraft, not the astronauts, control virtually the entire mission. Even the astronaut's commands must pass through the computers.

The shuttle is designed to be run by four computers that act in step using identical computer programs. The computers constantly check one another and "vote" on major decisions. If one computer breaks down, the other three can carry on.

NASA scientists realized, however, that if the computer programs were wrong, all four computers might malfunction simultaneously. Because of that, a fifth computer was added that had an independent program. It "listens" to the other four and is ready to step in should three or four of them fail.

NASA scientists said yesterday that what halted the mission was the failure of the standby computer to listen to two of the other four computers. The scientists had not determined whether the problem resulted from a hardware problem, meaning a breakdown in the computers themselves, from a software error or from some other cause.

Gentry Lee of the Jet Propulsion Labo-

ratory in Pasadena, Calif., who headed the review committee, said in a recent interview, "It was my feeling the upper management of the shuttle was too willing to make changes in software."

He said each change introduced another possibility for error.

The committee, composed of Mr. Lee and three experts from aerospace companies, also found that the programs that were written by Rockwell International for the backup computer were not being tested as extensively as the programs written by the International Business Machines Corporation for the four main computers. One of the items that was not given sufficient attention, according to a member of the committee who asked to remain unidentified, was the communications between the backup computer and the other computers.

"NASA and Rockwell developed an attitude that it is only a backup," he said, "so it doesn't have to be as reliable."

Both Mr. Lee and the other committee member said, however, that NASA had taken sufficient steps to react to the committee's suggestions, which were submitted last summer.

Other experts, like Professor Meyer of the University of Michigan, suggested that the use of four separate computers was not as sophisticated an approach as the use one computer with duplicated parts would have been. Professor Meyer acknowledged, however, that the shuttle was designed in the early 1970's, before many of the more sophisticated approaches were developed.