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NEWS RELEASE

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ARIANE 501 INQUIRY BOARD REPORTS

On June 4th, 1996 the maiden flight of the Ariane 5 launcher ended in a failure. Only about 40 seconds after initiation of the flight sequence, at an altitude of about 3700 meters, the launcher veered off its flight path, broke up and exploded. The following information has been excerpted from an ESA News Release made public at European Space Agency Headquarters in Paris, France on July 23, 1996.

Immediately after the failure, Mr. Jean-Marie Luton, ESA Director General, and Mr. Alain Bensoussan, CNES Chairman, set up an independent Inquiry Board (see ESA-CNES Press Release of 10 June 1996), which has now submitted its report.

The report begins by presenting the causes of the failure, with analysis of the flight data having indicated:

-nominal behavior of the launcher up to Ho + 36 seconds;
-simultaneous failure of the two inertial reference systems;
-swiveling into the extreme position of the nozzles of the two solid boosters and, slightly later, of the Vulcain engine, causing the launcher to veer abruptly;
-self-destruction of the launcher correctly triggered by rupture of the electrical links between the solid boosters and the core stage.

A chain of events, their inter-relationships and causes have been established, starting with the destruction of the launcher and tracing back in time towards the primary cause. These provide the technical explanations for the failure of the 501 flight, which lay in the flight control and guidance system. A detailed account is given in the report, which concludes:

> **"The failure of Ariane 501 was caused by the complete loss of guidance and attitude information 37 seconds after start of the main engine ignition sequence (30 seconds after lift-off). This loss of information was due to specification and design errors in the software of the inertial reference system. The extensive reviews and tests carried out during the Ariane 5 development program did not include adequate analysis and testing of the inertial reference system or of the complete flight control system, which could have detected the potential failure."**

Despite the series of tests and reviews carried out under the program, in the course of which thousands of corrections were made, shortcomings in the system approach concerning the software resulted in failure to detect the fault. It is stressed that alignment function of the inertial reference system, which served a purpose only before lift-off (but remained operative afterwards), was not taken into account in the simulations and that the equipment and system tests were not sufficiently representative.

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Without implicating the system architecture, the report makes a series of recommendations for ensuring that the launcher's software operates correctly. The Ariane 5 program will be taking action in line with all these recommendations, as follows:

-correction of the problem in the SRI (inertial reference system) that led to the accident;
-reexamination of all software embedded in equipment;
-improvement of the representativeness (vis a vis the launcher) of the qualification testing environment;
-introduction of overlaps and deliberate redundancy between successive tests:
--at equipment level,
--at stage level,
--at system level,
-improvement and systematization of the two-way flow of information:
--up from equipment to system: nominal and failure-mode behavior;
--down from system to equipment: use of equipment items in flight.

More specifically, the following corrective measures will be applied:

-to the inertial reference system:
--switch-off or inhibition of the alignment function after liftoff,
--analysis/modification of processing, particularly on detection of a fault (no processor shutdown),
--testing to check the coverage of the SRI flight domain;

-to the system qualification environment:
--general improvement of representativeness through systematic use of real equipment and components wherever possible,
--simulation of real trajectories on SRI electronics.

In addition, the following general measures will be taken:

-critical reappraisal of all software (flight program and embedded software),
-improvement of overall coordination relating to software.

The ESA Director General and CNES Chairman will be making a joint presentation of the plan of action put into effect and its programmatic consequences at a press conference in September.

AMSAT is a not-for-profit, 501(c)(3) educational and scientific organization that was first chartered in Washington, DC, USA. Its objectives include promoting space research and communication by building, launching and controlling Amateur Radio spacecraft. Since its founding, over 25 years ago, many other like-minded organizations have been formed around the world to pursue the same goals and who now also share the AMSAT name. Often acting together, these groups have used predominantly volunteer labor and donated resources to design, construct and, with the added assistance of government and commercial space agencies, successfully launch, over two dozen Amateur Radio communications satellites into Earth orbit.

The Phase 3-D satellite, now under construction with the help of over a dozen AMSAT groups on five continents, will be the largest, most complex, and most expensive Amateur Radio satellite ever built. It is currently slated for launch on the next Ariane 5 test mission, Ariane 502.

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