US space science

Centaur bites the dust

Washington

SPACE science suffered a further major setback last week with the announcement by the National Aeronautics and Space Administration (NASA) of its decision to abandon development of the Centaur upper stage for use aboard the space shuttle. The decision was taken because safety studies indicated that Centaur, which carries tens of tonnes of liquid hydrogen fuel and liquid oxygen, would constitute an unacceptable risk to the shuttle crew.

The immediate effect of the decision will be to delay until at least December 1989 two major space exploration missions that were to have been launched last month using the shuttle/Centaur launch combination: Ulysses, the European Space Agency mission to explore the poles of the Sun, and Galileo, the NASA/ West German mission to explore Jupiter and its moons. The Challenger disaster in January had already ensured that Ulysses and Galileo could not fly before 1988.

Other planned science missions that could have used the shuttle/Centaur combination may also be delayed by last week's decision, including the Magellan mission (formerly known as Venus Radar Mapper), CRAF (Comet Rendezvous and Asteroid Flyby), and Cassini, a Saturn orbiter and probe. But Dr Frank McDonald, NASA's chief scientist, said this week that he was confident that launch problems could be solved in time to avoid delaying these later missions.

According to the Federation of American Scientists, several Department of Defense missions, including the "Milstar" communications satellites, were to have used a version of the Centaur upper stage in the shuttle and will probably also face delays. Centaurs used with expendable rockets such as Titans and Atlases are not affected by last week's decision and may provide an alternative means of launching heavy satellites into Earth orbit or into planetary trajectories.

The shuttle/Centaur combination was already under scrutiny at the time of the Challenger accident, which further increased concern about safety; separate studies have been conducted by NASA and by Congress. In a letter to NASA administrator Dr James Fletcher, Congressmen Bill Green and Edward Boland of the House of Representatives' appropriations subcommittee that deals with NASA wrote last week that "since the accident the yardstick against which... risks will be measured has forever changed".

NASA officials interviewed for Green and Boland's study had mixed views about shuttle/Centaur. Some believed it could be made safe, but it was clear that at least

another \$175–200 million would be needed to do so and to absorb the delays caused by the Challenger accident.

Another new safety worry is that plutonium from the radio isotope thermal generators (RTGs) carried on Ulysses and Galileo could cause 200 cancer deaths and contaminate hundreds of square miles of Florida if it was dispersed in an explosion, according to studies carried out by the Department of Energy. Analyses of the Challenger accident suggest that the overpressures generated in a shuttle explosion are unlikely to rupture the RTGs, but nevertheless special protective shrouds were considered.

The delay to science missions will now depend on how soon the shuttle flies again (not thought likely before December 1987) and on what other launch vehicles can be developed.

Both Ulysses and Galileo were energetically very demanding launches; the Centaur's cryogenic motors represented the most compact and the lightest power source of sufficient capability.

At NASA's Jet Propulsion Laboratory in Pasadena the abandonment of Centaur was no surprise. Staff had been working on alternative launch possibilities for future planetary missions since it became clear after the Challenger accident that the performance of the shuttle would be impaired by the extra weight entailed by safety modifications. An energetically less demanding but more time-consuming delta-vega (ΔV) trajectory was already in prospect for Galileo before last week's decision, and other heavy orbiters of outer planets faced a similar prospect.

According to Allen Wolfe, deputy project manager for Galileo, one possibility for that mission is to use the shuttle with a solid fuel double Inertial Upper Stage. A special third-stage injection module that would be needed has, however, yet to be developed and could not be ready before 1991, according to one estimate. Wolfe had no cost estimates for the re-engineering that would be necessary.

Another possibility would be to use a Centaur with a Titan 34D-7, a new rocket being developed for the Department of Defense. But the new Titans cost more than \$200 million each, and as soon as they become available in 1988 they are likely to be fully booked by the military; current plans call for only five to be built each year between 1989 and 1992. And missions to the outer planets launched from a Titan-Centaur would all have to employ delta-vega trajectories, which can increase total journey time by two or three years. Last but not least, a completely new upper-stage design is by no means ruled out.

Tim Beardsley

Chinese rockets

Stealing a march on the West

LAST autumn, China formally announced that it was willing to launch satellites for other countries on a commercial basis, using its Long-March-2 and Long-March-3 rockets. At that time, this was viewed internationally more as a declaration of Chinese confidence in its space programme than as a serious tender for clients. The Challenger disaster and the Ariane failure last month have, however, forced a number of space agencies to think seriously about the Chinese proposal, particularly now that Western insurance companies are refusing to insure satellites. On 6 June, Mr Sun Jiadong, the Chinese Vice-Minister of Astronautics, announced at a press conference that the People's Insurance Company of China will offer "below-market" insurance rates for such launches.

According to Sun, China has so far been approached by eight potential launch customers; Sweden, the United States, the United Kingdom, the Netherlands, Canada, Australia, Pakistan and Indonesia.

The first country to sign an option agreement was Sweden, for its projected *Mailstar* communications satellite, which weighs only 100 kg and so would in any case be too small for Ariane. But the first country actually to use the Chinese facilities, Sun said, will probably be the United States, as the Western Union Corporation signed a memorandum with China last month on the launching of two communications satellites.

At present, China has the capacity to launch 10–12 rockets per year, Sun said. The maximum payload is 1.4 tonnes, but this will shortly be raised to 2.5 tonnes. An obstacle to the conclusion of launch contracts was, according to a US space team which visited China last year, that the Chinese do not provide good ground test data on their vehicles. But what appeared a major obstacle in 1985 may well not seem so in the aftermath of Challenger and Ariane.

Foreign clients will not be able to be present at the launch site at least for the time being. But this, according to Mr Shen Rongjun, vice chairman of the Science and Technology Committee of the Commission of Science, Technology and Industry for National Defence, is simply because there are no facilities for guests at the site. Foreign visitors are welcome, he said, at the Jiuquan centre, which has received more than 30 such delegations in the past few years. As soon as the necessary conditions are provided at the launch site, Shen said, visitors will be welcome there too.

Vera Rich