SOLAR SYSTEM TECHNOLOGY

Technology Is Essential, But It's a Tough Sell

Developing new technology is not as exciting as sending a probe into deep space, so NASA keeps relying on age-old hardware

WASHINGTON, D.C.—Off-the-shelf technology is no match for Mercury's broiling temperatures or Jupiter's deadly magnetic field. But planetary scientists face the daunting prospect of planning 21st century explorations of more hostile regions of the solar system for longer periods with technology largely unchanged since the 1970s heyday of Voyager and Viking. When it comes to speed, power, and communications systems, says NASA space science chief Ed Weiler in frustration, "we are doing missions the way we did them 40 years ago."

The problem is twofold. First, investment in technology lacks the appeal of dramatic missions to a comet, asteroid, or planet. The Deep Space 1 mission, built for the bargain price of $160 million and turned off last month after a 3-year voyage, successfully tested an innovative ion engine as a more efficient alternative to chemical rockets—yet its visit to a comet is what captured public and scientific attention. More typical is Congress's decision in November to take nearly half of the $20 million NASA wanted to spend in 2002 on developing in-space propulsion systems and reassign it to construction projects. That shift will force NASA to scale back planned work on aerocapture—using the atmosphere as a natural brake for spacecraft—as well as on promising nuclear and ion engine research.

A second problem lies in public and political nervousness over the use of nuclear fuel—whether to supply electricity for operating instruments or for propulsion. Missions far from the sun require more power and reliability than current solar arrays can provide and so use plutonium-powered electrical systems, euphemistically called radioisotope thermal generators (RTGs). The plutonium fuel simply gives off heat, which the RTG easily converts into electricity. Equipped with RTGs, the Viking landers of the mid-1970s kept working into the early 1980s.

In contrast, the solar-powered rover used in 1997 on Mars Pathfinder operated for only a month before martian dust obscured its solar panels. A similar fate awaits the rovers on the next Mars landing, scheduled for early 2004. That limitation worries NASA planners. "Without RTGs, we're not going anywhere," says Colleen Hartman, NASA solar system chief. "It's number one on our tech list; nothing else comes close."

Plutonium power? The Cassini mission to Saturn uses radioisotopes, but protesters worry about an accident that could spread deadly radiation.

It's number one for a very good reason. Only two RTGs are left, and demand exceeds supply: One is needed for a Pluto mission and two for a Europa flight, although the future of both missions is in question. To start up a new line, NASA must negotiate with the Department of Energy, which is responsible for overseeing construction of the generators and finding the necessary plutonium-238 fuel. One source is Russia, which has an agreement to sell plutonium to the United States at $2 million per kilogram.

Until recently, there seemed to be no solution to the RTG shortage. The Clinton Administration frowned on the use of nuclear fuel, and activists have waged a bitter, although ultimately unsuccessful, battle against spacecraft such as Saturn-bound Cassini that carry RTGs. They worry that an accident during launch or during an Earth flyby could expose the planet to deadly plutonium.

And nuclear propulsion would almost certainly face similar opposition. "There's no doubt it would allow us incredibly quick trip times, but we have to wrestle with severe political issues," says Wesley Huntress, a geophysicist at the Carnegie Institution of Washington. A former NASA space science chief, Huntress is leading the technology panel for the National Research Council's (NRC's) solar system survey due out in the spring (see p. 32).

The arrival of a Republican Administration could herald a new day for nuclear electric power and, perhaps, even propulsion. "We are not afraid to use the 'N' word anymore in Washington," says Weiler. Although White House officials declined to comment on the topic, Weiler adds that it is no longer inconceivable that the president could support a 10-year NASA plan to spend $1 billion developing nuclear-based power systems. The first sign of such support could be in the 2003 budget request to be released next month.

Charles Elachi, director of the Jet Propulsion Laboratory in Pasadena, California, recently argued that advanced propulsion would give NASA more time to develop a Pluto craft and still reach the planet by 2020, after which time its atmosphere is likely to be frozen for decades. With new systems such as the one demonstrated by Deep Space 1, he says, "you can go to Pluto anytime." But many researchers are skeptical. They are unwilling to let go of a mission in hand, now tentatively set to launch in 2006, for a vague promise of high technology in the future.

Academic and NASA officials agree that part of the problem is cultural. Engineers and scientists simply don't talk to each other enough. NASA high-tech funding typically flows to aerospace companies with few ties to academic institutions, and universities spend too little time communicating their scientific needs to industry. However, all sides agree on one thing: The NRC survey must make a strong case for the importance of new technology, even at the risk of jeopardizing some near-term missions, if scientists are to have any chance of powering future missions with something better than what is already on NASA's shelf.

—ANDREW LAWLER

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