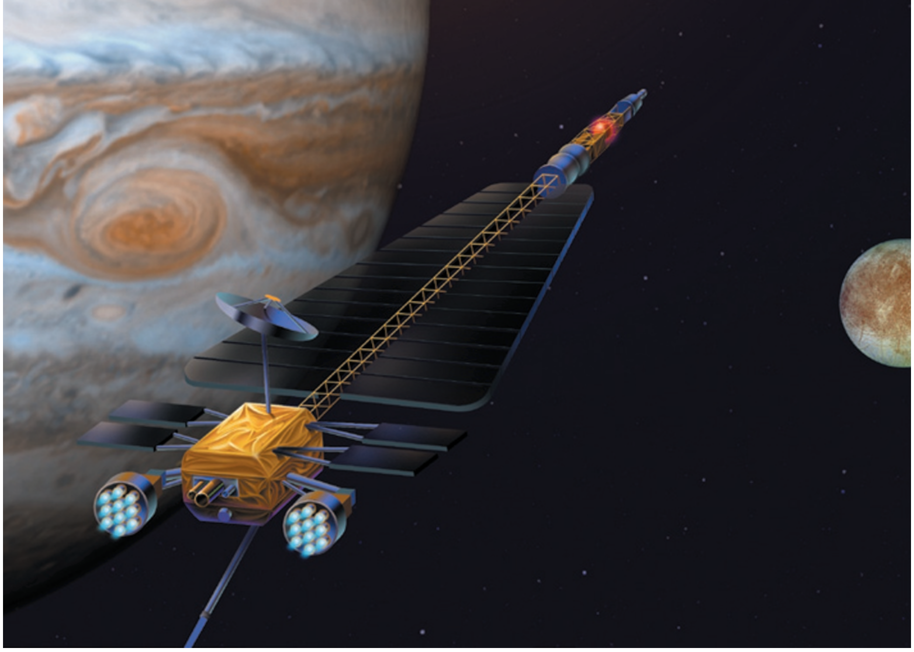


NASA/JPL

A mission to Jupiter's large icy moons, cancelled in 2006, would have been powered by a nuclear reactor.

SPACE SCIENCE

Fission power back on NASA's agenda

Space-technology report prioritizes nuclear propulsion.

BY ERIC HAND

Michael Houts wants astronauts to ride a nuclear reactor to Mars. He is convinced that small amounts of uranium-235 — which has an energy density one million times greater than that of liquid fuels — could power rockets efficiently, using the heat of fission to accelerate small stores of lightweight hydrogen propellant. But although Houts, the nuclear-research manager at NASA's Marshall Space Flight Center in Huntsville, Alabama, has an unwavering belief in the potential of space-based nuclear power and propulsion, the funding to develop that technology has been inconsistent. This year, he is leading a nuclear-propulsion project with a budget of US$3 million — minuscule in comparison with the $1.3 billion that NASA will spend on space-technology research and development in the 2012 fiscal year. "The funding at times has gone to zero," says Houts. "You lose the teams and the momentum."

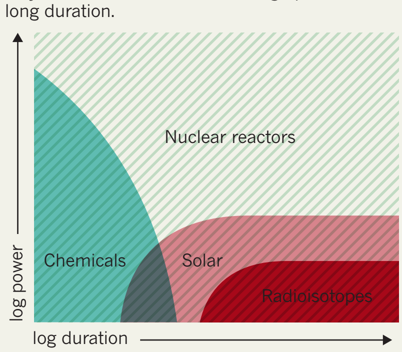
Yet a report released on 1 February by the US National Research Council could change Houts's fortunes. *Space Technology Roadmaps and Priorities* is the first ever community-based document to set priorities for NASA's space-technology division. The report's steering committee spent a year canvassing opinion in both industry and academia to create a ranked list of the 16 most important areas of technology development, out of a potential 320 topics. Nuclear power and propulsion came high on the list. "It would change exploration in a fundamental way forever," says Raymond Colladay, chairman of the committee and former president of Lockheed Martin Astronautics in Denver, Colorado.

Other technologies were ranked higher. For instance, the committee put an emphasis on developing 'star shades' and coronagraphs to block the light of distant stars and allow space telescopes to discern the faint light of planets orbiting them. And the report prioritized the development of ways to protect astronauts from radiation on long missions.

But the committee also said that small fission reactors could revolutionize the exploration of the Solar System by both humans and robots. Reactors could support long-lasting experiments on the surface of planets and power missions to the outer Solar System, where the Sun is too distant to provide much power for even the most efficient solar panels. And once human space exploration gets going, nuclear propulsion systems may be essential for multi-year trips to the asteroids or Mars. With twice the efficiency of chemical rockets, reactors could push astronauts not just farther, but also faster than ever before (see 'Power drive') — which could help to reduce explorers' exposure to space radiation.

POWER DRIVE

Of the available sources of energy for space flight, only nuclear fission offers both high power and long duration.



SOURCE: IAEA

Mason Peck, NASA's chief technologist, says that he will use the priority list as a guide when setting funding in future. However, developing fission power for space will require not only money, but also political will: the image of a nuclear-powered spacecraft blowing up on the launch pad or on its way to orbit is a powerful deterrent. Houts says that the risk of nuclear material contaminating Earth after an accident is negligible because the reactor would not be started until the system were in orbit. Nevertheless, past attempts to demonstrate the technology have faltered. In 2003, NASA began Project Prometheus, which supported the development of a nuclear reactor that would drive an electric ion thruster to power a probe to Jupiter. The programme received as much as $430 million in 2005, but was cancelled a year later as NASA shifted its resources towards returning to the Moon — a destination for which nuclear propulsion was not needed.

Although the project has disappeared, it did support work that is now bearing fruit in the form of a new radioisotope power generator — a power source that does not use fission, but instead relies on the natural heat from the decay of plutonium. The Advanced Stirling Radioisotope Generator (ASRG) is lighter and more efficient than previous examples, and the space-technology report identified it as a "tipping point" technology that is almost ready for in-flight demonstration. Two mission proposals that include the ASRG — one to explore the hydrocarbon seas of Saturn's moon Titan in a boat, the other to hop from comet to comet — are under consideration at NASA.

Houts thinks that the radioactive power source for these missions would not generate much political controversy — certainly nothing like the protests when the Cassini–Huygens mission was sent to Saturn in 1997 with an earlier version of a radioistotope generator. Nowadays, Houts often opens his academic talks by asking whether the audience is aware that there is plutonium on board the Mars Science Laboratory, a mission that was launched in November 2011 to take a massive rover to Mars. About half are not, he says. "In a strange way, I feel that's good news," says Houts. "It seems like it's becoming a very accepted technology." ■