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Ira L. Mills,

*Departmental Clearance Officer.*

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## NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

[Notice 04-054]

### National Environmental Policy Act; Mars Exploration Program

**AGENCY:** National Aeronautics and Space Administration (NASA).

**ACTION:** Notice of availability of draft programmatic environmental impact statement (DPEIS) for implementation of the Mars Exploration Program.

**SUMMARY:** Pursuant to the National Environmental Policy Act of 1969, as amended (NEPA) (42 U.S.C. 4321 *et seq.*), the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA (40 CFR parts 1500-1508), and NASA policy and procedures (14 CFR part 1216 subpart 1216.3), NASA has prepared and issued a DPEIS for the Mars Exploration Program (MEP). The DPEIS addresses the potential environmental impacts associated with continuing the preparations for and implementing the program.

The MEP would be a science-driven, technology-enabled effort to characterize and understand Mars using an exploration strategy, which focuses on evidence of the presence of water. Following the pathways and cycles of water may lead to preserved ancient records of biological processes, as well as the character of environments on Mars. The Proposed Action addresses the preparation for and implementation of a coordinated series of robotic orbital, surface, and atmospheric missions to gather scientific data on Mars and its environments through 2020. Continued planning for sample return missions, which would enable study of Martian samples in Earth-based laboratories, would be included. Some MEP missions could use radioisotope power systems (RPSs) for electricity, radioisotope heater units (RHUs) for thermal control, and small quantities of radioisotopes in science instruments for experiments and instrument calibration. Environmental impacts associated with specific missions would be addressed in subsequent environmental documentation, as appropriate.

Missions launched from the United States would originate from either Cape Canaveral Air Force Station (CCAFS), Florida or Vandenberg Air Force Base (VAFB), California.

**DATES:** Interested parties are invited to submit comments on environmental concerns on or before June 7, 2004, or 45 days from the date of publication in the **Federal Register** of the EPA notice of availability of the MEP DPEIS, whichever is later.

**ADDRESSES:** Comments submitted via first class, registered, or certified mail should be addressed to Mark R. Dahl, Office of Space Science, Mail Code SM, NASA Headquarters, Washington, DC 20546-0001. Comments submitted via express mail, a commercial deliverer, or courier service should be addressed to Mark R. Dahl, Office of Space Science, Mail Code SM, Attn: Receiving & Inspection (Rear of Building), NASA Headquarters, 300 E Street SW., Washington, DC 20024-3210. While hard copy comments are preferred, comments by electronic mail may be sent to [mep.nepa@hq.nasa.gov](mailto:mep.nepa@hq.nasa.gov). The DPEIS may be reviewed at the following locations:

- (a) NASA Headquarters, Library, Room 1J20, 300 E Street, SW., Washington, DC 20546.
  - (b) Jet Propulsion Laboratory, Visitors Lobby, Building 249, 4800 Oak Grove Drive, Pasadena, CA 91109 (818-354-5179).
- In addition, the DPEIS may be examined at the following NASA locations by contacting the pertinent Freedom of Information Act Office:
- (c) NASA, Ames Research Center, Moffett Field, CA 94035 (650-604-1181).
  - (d) NASA, Dryden Flight Research Center, P.O. Box 273, Edwards, CA 93523 (661-258-3449).
  - (e) NASA, Glenn Research Center at Lewis Field, 21000 Brookpark Road, Cleveland, OH 44135 (216-433-2755).
  - (f) NASA, Goddard Space Flight Center, Greenbelt Road, Greenbelt, MD 20771 (301-286-6255).
  - (g) NASA, Johnson Space Center, Houston, TX 77058 (281-483-8612).
  - (h) NASA, Kennedy Space Center, FL 32899 (321-867-9280).
  - (i) NASA, Langley Research Center, Hampton, VA 23681 (757-864-2497).
  - (j) NASA, Marshall Space Flight Center, Huntsville, AL 35812 (256-544-2030).
  - (k) NASA, Stennis Space Center, MS 39529 (228-688-2164).

Limited hard copies of the DPEIS are available, on a first request basis, by contacting Mark R. Dahl at the address

or telephone number indicated herein. The DPEIS also is available in Acrobat® format at <http://spacescience.nasa.gov/admin/pubs/mepdpeis/index.htm>.

**FOR FURTHER INFORMATION CONTACT:** Mark R. Dahl, Office of Space Science, Mail Code SM, NASA Headquarters, Washington, DC 20546-0001, telephone 202-358-4800, or electronic mail [mep.nepa@hq.nasa.gov](mailto:mep.nepa@hq.nasa.gov).

**SUPPLEMENTARY INFORMATION:** With the MEP, NASA would establish a series of objectives to address the open scientific questions associated with the exploration of Mars. These objectives have been organized by the program as follows:

- Determine if life exists or has ever existed on Mars,
- Understand the current state and evolution of the atmosphere, surface, and interior of Mars, and
- Develop an understanding of Mars in support of possible future human exploration.

The purpose of the action addressed in the DPEIS is to further the scientific goals of the MEP by continuing the exploration and characterization of the planet. On the basis of the knowledge gained from prior and ongoing missions (*i.e.*, the early Mariners, Viking, Mars Pathfinder, Mars Global Surveyor, and Mars Odyssey), it appears that Mars, like Earth, has experienced dynamic interactions among its atmosphere, surface, and interior that are, at least in part, related to water. Following the pathways and cycles of water has emerged as a strategy that possibly may lead to a preserved record of biological processes, as well as the character of ancient environments on Mars. In addition to understanding the history of Mars, investigations undertaken in the MEP may shed light on current environments that could support existing biological processes.

The Proposed Action (Alternative 1) would consist of a long-term program that, as a goal, sends at least one spacecraft to Mars during each launch opportunity extending through the first two decades of the twenty-first century. Efficient launch opportunities to Mars occur approximately every 26 months. MEP missions would be launched on expendable launch vehicles (*e.g.*, Delta or Atlas class) from either CCAFS, Florida, or VAFB, California.

International participation in the MEP could include, but not be limited to, the Canadian Space Agency, the European Space Agency (ESA), the French Space Agency, the German Space Agency, the Italian Space Agency, and the Russian Space Agency. The MEP could include international missions in which NASA

proposes to be a participant that are to be launched from a foreign site. Under the Proposed Action, the MEP would consist of a series of robotic orbital, surface, and atmospheric missions to Mars. Some spacecraft could use RPSs for continuous electrical power, RHUs for thermal control, and small quantities of radioisotopes in science instruments for experiments and instrument calibration.

At this time, it is envisioned that the MEP missions through the first decade would consist of the following:

- NASA's Mars Odyssey orbiter, which was launched on April 7, 2001, and is currently in orbit about Mars.
- NASA's Mars Exploration Rovers project, which consists of two missions that sent two identical rovers to two different sites on the surface of Mars. Spirit and Opportunity were launched in June and July 2003, respectively, and successfully landed on Mars in January 2004. Both rovers are currently operating on Mars.
- ESA's Mars Express mission, which consists of an orbiter and the Beagle 2 lander, launched in June 2003. Mars Express successfully entered orbit at Mars on December 25, 2003 (Beagle 2 was deemed lost after attempts to communicate with it failed after the scheduled landing on December 25).
- NASA's Mars Reconnaissance Orbiter, which is proposed for launch in 2005, and is intended to narrow the focus of potential landing sites to search for the most compelling indicators for bearing life.
- A series of small, narrowly focused missions, called Mars Scouts, is currently proposed to explore Mars at every other launch opportunity beginning in 2007. The first Mars Scout mission, a lander called Phoenix, would be launched during this opportunity.
- NASA's Mars Science Laboratory (MSL), proposed for launch in 2009, would conduct surface and sub-surface investigations to examine the aqueous history of Mars and search for potential building blocks of life. The MSL could utilize a RPS to provide uninterrupted electrical power. NASA also proposes to launch a Mars Telecommunications Orbiter during the 2009 opportunity.
- A second Mars Scout mission is proposed for launch during the 2011 opportunity.

Missions beyond 2011 could use orbiters, rovers, and landers and could include the first mission to return Martian samples. As new information and techniques become available during

the course of the program, the timing, focus, and objectives of MEP missions in the second decade could be redirected.

Alternatives to the Proposed Action evaluated in the DPEIS include the following:

- Under Alternative 2, NASA would continue to explore Mars through 2020, but on a less frequent, less comprehensive, mission-by-mission basis. These missions may include international partners. Any mission proposed to continue the exploration of Mars would be developed and launched within the broader context of all other missions proposed for exploring other parts of the solar system. Robotic orbital, surface, and atmospheric missions could be used to explore Mars and could include sample return missions. Landed spacecraft could use RPSs for power generation or RHUs for thermal control of temperature-sensitive components in the spacecraft. Some spacecraft may carry small quantities of radioisotopes in science instruments for experiments and for instrument calibration.
- Under the No Action Alternative, NASA would discontinue planning for and launching robotic missions to Mars through 2020. Currently operating NASA spacecraft at or en route to Mars would continue their missions to completion. New science investigations of Mars would only be made remotely from Earth-based assets, *i.e.*, ground- or space-based observatories, or from spacecraft developed and launched to Mars by non-U.S. space agencies.

The environmental impacts of the Proposed Action and Alternatives are discussed in the DPEIS from a programmatic perspective. Because the DPEIS is being prepared during the planning stages for the MEP, specific proposed projects and missions within the MEP are only addressed in terms of a broad, conceptual framework. Each project or mission within the MEP that would propose use of RPSs or RHUs would be the subject of additional environmental documentation. While detailed analyses and test data for each spacecraft-launch vehicle combination are not yet available, there is sufficient information from previous programs and existing NEPA documentation to assess the potential environmental impacts.

A major component of the MEP is continued planning for one or more missions that would return samples from Mars. At the time of publication of the DPEIS, preliminary concepts for a

sample return mission are being studied and would continue to be refined and evaluated. A sample return mission would be the subject of separate environmental documentation, as would the location, design and operational requirements for a returned-sample receiving facility. NASA may also propose to participate in international missions to Mars to be launched from foreign locations. In such an event, NASA will prepare environmental documentation in accordance with Executive Order 12114, Environmental Effects Abroad of Major Federal Actions. The non-radiological environmental impacts associated with normal spacecraft launches from both CCAFS and VAFB have been addressed in previous U.S. Air Force and NASA environmental documentation. Rocket launches are discrete events that cause short-term impacts on local air quality. However, because launches are relatively infrequent events, and winds rapidly disperse and dilute the launch emissions to background concentrations, long-term effects from exhaust emissions would not be anticipated. If solid rocket motors are used, surface waters in the immediate area of the exhaust cloud might temporarily acidify from deposition of hydrogen chloride. Launching a mission during each opportunity to Mars (approximately every 26 months) under the Proposed Action or less frequently under Alternative 2 would result in negligible release of ozone-depleting chemicals with no anticipated long-term cumulative impacts.

One or more of the missions to Mars could propose the use of radioisotopes under the Proposed Action and Alternative 2. Small quantities of radioisotopes may be used for instrument calibration or to enable science experiments, and RHUs or RPSs containing varying amounts of plutonium dioxide may be used to supply heat and electric power, respectively. Under both alternatives NASA will determine the appropriate level of NEPA documentation required for any mission proposing use of radiological material. If required, a nuclear risk assessment will be developed by the U.S. Department of Energy to address the human health and environmental risks associated with the use of radioactive material. Many of the parameters that determine the risks for a specific mission are expected to be similar to those associated with previous missions (*e.g.*, Galileo, Ulysses, Cassini, and the Spirit and Opportunity rovers). Mission-specific factors that affect the estimated risk include the

amount and type of radioactive material used in a mission, the protective features of the devices containing the radioactive material, the probability of an accident which can damage the radioactive material, and the accident environments (*e.g.*, propellant fires, debris fragments, and blast overpressure). The risks associated with a Mars exploration mission carrying radioactive material are, therefore, expected to be similar to those estimated for earlier missions. The population and individual risks associated with prior missions that have made use of radioactive material have all been shown to be relatively small.

Any person, organization, or governmental body or agency interested in receiving a copy of NASA's Record of Decision after it is rendered should so indicate by mail or electronic mail to Mr. Dahl at the addresses provided above.

**Jeffrey E. Sutton,**

*Assistant Administrator for Institutional and Corporate Management.*

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## **NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**

[Notice 04-053]

### **National Environmental Policy Act; Development of Advanced Radioisotope Power Systems**

**AGENCY:** National Aeronautics and Space Administration (NASA).

**ACTION:** Notice of intent to prepare a Tier I Environmental Impact Statement (EIS) and to conduct scoping for the development of advanced Radioisotope Power Systems.

**SUMMARY:** Pursuant to the National Environmental Policy Act of 1969 (NEPA), as amended (42 U.S.C. 4321 *et seq.*), the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA (40 CFR parts 1500-1508), and NASA's policy and procedures (14 CFR subpart 1216.3), NASA intends to conduct scoping and to prepare a Tier I EIS for the development of advanced Radioisotope Power Systems (RPSs). NASA, in cooperation with the U.S. Department of Energy (DOE), proposes to develop in the near-term two types of advanced RPSs to satisfy a wide of range of future space exploration mission requirements. These advanced RPSs would both be capable of functioning in the vacuum of space and in the environments encountered on the

surfaces of planets, moons and other solar system bodies. These new power systems would be based upon a modified version of the General Purpose Heat Source (GPHS) previously developed by DOE and used in the Radioisotope Thermoelectric Generators (RTGs) for NASA's Galileo, Ulysses, and Cassini missions. This modification would add additional graphite material to the graphite aeroshell. The GPHS-based advanced RPSs would be capable of providing long-term, reliable electrical power to spacecraft across the range of conditions encountered in space and planetary surface missions.

The Tier 1 EIS will also address in general terms the development and qualification for flight of advanced RPSs that use passive or dynamic systems to convert the heat generated from the decay of plutonium to electrical energy, and related long-term research and development of technologies that could further enhance the capability of future RPS systems. The Multi-Mission Radioisotope Thermoelectric Generator (MMRTG) and Stirling Radioisotope Generator (SRG) development activity would include, but not necessarily be limited to: (1) New power conversion technologies to more efficiently use the heat energy from the GPHS module, and (2) improving the versatility of the RPS so that it would be capable of operating for extended periods in the vacuum of space and in planetary atmospheres. Specific future developments of a new generation of space qualified RPSs (*e.g.*, more efficient systems than the proposed MMRTG or SRG, or systems with smaller electrical power output) would be the subject of separate Tier II environmental documentation.

DOE will be a cooperating agency in the preparation of this Tier 1 EIS.

**DATES:** Interested parties are invited to submit comments on environmental concerns in writing on or before June 7, 2004, to assure full consideration during the scoping process.

**ADDRESSES:** Comments should be addressed to Dr. George Schmidt, NASA Headquarters, Code S, Washington, DC 20546-0001. While hardcopy comments are preferred, comments may be sent by electronic mail to: [rpseis@nasa.gov](mailto:rpseis@nasa.gov).

**FOR FURTHER INFORMATION CONTACT:** Dr. George Schmidt, NASA Headquarters, Code S, Washington, DC 20546-0001, by telephone at 202-358-0113, or by electronic mail at [rpseis@nasa.gov](mailto:rpseis@nasa.gov).

**SUPPLEMENTARY INFORMATION:** NASA's future scientific exploration of the solar system is planned to include missions throughout the solar system and potential missions to the surfaces of planets, moons and other planetary

bodies. Many of these missions cannot be accomplished with current energy production and storage technologies available to NASA, such as batteries, solar arrays, fuel cells, and the existing radioisotope power system (the GPHS RTG). To enable this broad range of missions, NASA is proposing to develop in the near-term, two types of RPSs capable of functioning both in the vacuum of space and in the environments encountered on the surfaces of planets, moons and other planetary bodies.

NASA proposes to develop these advanced RPSs to enable missions with substantial longevity, flexibility, and greater scientific exploration capability. Some possibilities are:

- Comprehensive and detailed planetary investigations and creating comparative data sets of the outer planets—Jupiter, Saturn, Uranus, Neptune and Pluto and their moons. The knowledge gained with these data sets would be vital to understanding other recently discovered planetary systems and general principles of planetary formation.

- Comprehensive exploration of the surfaces and interiors of comets, possibly including returned samples to better understand the building blocks of our solar system and ingredients contributing to the origin of life.

- Expanded capabilities for surface and on-orbit exploration, and sample return missions to Mars and other planetary bodies (including the Earth's moon) to greatly improve our understanding of planetary processes, particularly those affecting the potential for life.

The current DOE radioisotope power system, the GPHS RTG, does not meet these new or evolving mission requirements. The heat-to-electricity converter for the existing RTG produces about 285 watts of electrical power, but it is not designed to perform for an extended period in planetary atmospheres such as that on Mars. The two new proposed types of RPSs would be developed to meet the diverse needs of future NASA space exploration missions.

Near-term advanced RPS development would focus on two power systems, the MMRTG and the SRG. The MMRTG would build upon the spaceflight-proven passive thermoelectric power conversion technology incorporating improvements to allow extended operation in planetary atmospheres. For the SRG, NASA would develop a new space-qualified dynamic power conversion system, a Stirling engine, that would more efficiently convert the heat from