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None.

Signed at Washington, DC this 30th day of April, 1998.

Alexis M. Herman,

Secretary of Labor.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

[Notice 98-062]

National Environmental Policy Act; Stardust mission

AGENCY: National Aeronautics and Space Administration (NASA).

ACTION: Finding of no significant impact.

SUMMARY: Pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321, *et seq.*), the Council on Environmental Quality (CEQ) 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 made a finding of no significant impact (FONSI) with respect to the proposed Stardust mission, which would involve a flight to the comet 81-P/Wild-2 and return of cometary and interstellar dust samples to Earth. The baseline mission calls for the Stardust spacecraft to be launched aboard a Delta II 7426 from Cape Canaveral Air Station (CCAS), Florida, in February 1999, and to return the sample return canister (SRC) to Utah Test and Training Range (UTTR) approximately 65 kilometers (40 miles) southwest of Salt Lake City, Utah in January 2006.

DATE: Comments in response to this notice must be provided in writing to NASA on or before June 8, 1998.

ADDRESSES: Comments in response to this FONSI should be addressed to Mr. Mark Dahl, NASA Headquarters, Code SD, 300 E Street SW, Washington, DC 20546. The Environmental Assessment (EA) prepared for the Stardust mission which supports this FONSI may be reviewed at:

(a) NASA Headquarters, Library, Room 1J20, 300 E Street SW, Washington, DC 20546

(b) NASA, Spaceport USA, Room 2001, John F. Kennedy Space Center, Florida, 32899 (407-867-2622). Please call Lisa Fowler beforehand at 407-867-2468 so that arrangements can be made.

(c) Jet Propulsion Laboratory, Visitors Lobby, Building 249, 4800 Oak Grove Drive, Pasadena, CA 91109 (818-354-5179)

The EA may also be examined at the following NASA locations by contacting the pertinent Freedom of Information Act Office:

(d) NASA, Ames Research Center, Moffet Field, CA 94035 (415-604-4191)

(e) NASA, Dryden Flight Research Center, Edwards, CA 93523 (805-258-2663)

(f) NASA, Goddard Space Flight Center, Greenbelt, MD 20771 (301-483-6255)

(g) NASA, Johnson Space Center, Houston, TX 77058 (281-483-8612)

(h) NASA, Langley Research Center, Hampton, VA 23665 (757-864-2497)

(i) NASA, Lewis Research Center, 21000 Brookpark Road, Cleveland, OH 44135 (216-433-2755)

(j) NASA, Marshall Space Flight Center, Huntsville, AL 35812 (256-544-5549)

(k) NASA, Stennis Space Center, MS 39529 (601-688-2164)

A limited number of copies of the EA are available for persons wishing a copy by contacting Mr. Dahl, at the address or telephone number indicated herein.

FOR FURTHER INFORMATION CONTACT: Mark Dahl, 202-358-1544.

SUPPLEMENTARY INFORMATION: NASA has reviewed the EA prepared for the Stardust mission and has determined that it represents an accurate and adequate analysis of the scope and level of associated environmental impacts. The EA is hereby incorporated by reference in this FONSI.

NASA is proposing to launch the Stardust mission, which would deliver a single spacecraft within 150 to 1000 kilometers (km) (93 to 620 miles [mi]) of the 81-P/Wild-2 comet nucleus during a flyby in 2004 to gather 1000 dust particles from the comet's coma. The proposed action calls for using a Delta II 7426 launch vehicle with a Star 37FM upper stage to inject the Stardust spacecraft into its initial heliocentric orbit in February 1999. The proposed mission design calls for the Stardust spacecraft to swing by Earth once during its seven-year tour. This gravity assist would allow the spacecraft to gain the additional energy required to intercept the comet Wild-2. During its flight, Stardust would transmit pictures of the Earth and Moon taken during the Earth swingby, transmit pictures of the comet nucleus and coma taken during comet encounter, nondestructively capture interstellar and cometary dust particles, and return these samples to Earth for study by the international scientific community. Neither the spacecraft nor the return canister would carry radioactive material.

The primary science objective for the Stardust mission is to non-destructively collect comet dust particles greater than 15 microns (μm) in size, at an encounter velocity of less than 6.5 km/second (s) (4 mi/s), and return them to Earth for scientific study.

Secondary and tertiary scientific objectives include the collection of intact particles from the Interstellar Dust Stream impinging into our solar system; provide multiple images of Wild-2, with ten times the resolution of any comet image to date, taken within 2000 km (1240 mi) of the comet nucleus; provide in-situ particulate analysis capable of resolving abundant elements in cometary fields for dust particles during the coma fly-through; provide in-situ particulate analysis for interstellar dust particles and planetary dust; collect comet coma molecules and return them to Earth; provide dust flux

measurement of particulates having a mass less than 1 gram; and measure the dust mass flux, number of large particulates, and comet mass upper limit. The Stardust mission is proposed to gather interstellar and cometary material and return it to Earth where the world scientific community can systematically analyze it with powerful research equipment in their laboratories.

Samples from Wild-2 would offer a glimpse of the best preserved fundamental building blocks out of which our Solar System formed. In addition, during its first two orbits about the Sun on its way to Wild-2, the Stardust spacecraft would collect approximately 100 interstellar dust particulates. This would provide the international scientific community its first opportunity to collect and analyze these interstellar dust grains.

Alternatives that were evaluated include: (1) No-Action (i.e., no Stardust mission); (2) launch vehicles options, including the Space Shuttle, Taurus, and Atlas configurations, as well as other Delta configurations; and (3) alternative landing sites. Failure to undertake the Stardust mission would disrupt the execution of NASA's Solar System Exploration Program as defined by the Agency's Solar System Exploration Committee. The scientific value of having actual bona-fide, relatively pristine comet samples is high. While environmental impacts would be avoided by cancellation of the proposed mission, the loss of the scientific knowledge and database from carrying out the mission could be substantial. Of the launch vehicles evaluated, the Delta II 7426/Star 37 FM most closely matches the Stardust mission requirements, and minimizes adverse environmental impacts within the cost constraints of this Discovery Mission.

Expected impacts to the human environment associated with the mission arise almost entirely from the normal launch of the Delta II 7426, and to a much lesser extent, the entry, descent, landing, and recovery operations of the sample return. Air emissions from the exhaust produced by the solid propellant graphite epoxy motors (GEMs) and liquid first stage primarily include carbon monoxide, hydrochloric acid, aluminum oxide in soluble and insoluble forms, carbon dioxide, and deluge water mixed with propellant by-products. Air impacts will be short-term and not substantial. Short-term water quality and noise impacts, as well as short-term effects on wetlands, plants, and animals, would occur in the vicinity of the launch complex. These short-term impacts are of a nature to be

self-correcting, and none of these effects would be substantial. There could be no impact on threatened or endangered species or critical habitat, cultural resources, or floodplains at or in the vicinity of CCAS. Accident scenarios have also been addressed and would not result in substantial environmental impacts.

The second stage would be ignited at an altitude of 118 kilometers (74 miles), which is in the ionosphere. Although the second stage would achieve orbit, its orbital decay time would fall below the limit NASA has set for orbital debris consideration. After burning its propellant to depletion, the second stage would remain in low Earth orbit (LEO) until its orbit eventually decayed. The second stage is designed to burn up as it reenters Earth's atmosphere. The Stardust Project will follow the NASA guidelines regarding orbital debris and minimizing the risk for uncontrolled reentry into the Earth's atmosphere.

The level and scope of environmental impacts associated with the launch of the Delta II 7426 vehicle are well within the envelope of impacts that have been addressed in previous FONSIs concerning other launch vehicles and spacecraft.

At capture, the comet and interstellar dust particles would be traveling at very high speed relative to the spacecraft collector and would be stopped in 1 to 3 centimeters (cm) of glass (aerogel) within microseconds. The particles would undergo extreme heating during impact and capture. This is a much more severe environment than any known sterilization techniques these particles might be subjected to on Earth. Because there is little possibility of biological contamination during sample collection, and thus an insignificant chance of returning any living organism to Earth (known as back-contamination), the Stardust project has requested and received certification from NASA's Planetary Protection Officer as a Planetary Protection Category V mission, "Unrestricted Earth Return," for the inbound mission phase.

Upper altitude emissions associated with reentry of the sample return capsule (SRC) would include ablation products of the thermal protection system on the forebody. The SRC would enter the earth's atmosphere directly above UTTR's South Range with a velocity of approximately 13 km/s (8 mi/s). It would decelerate to 600 meters/s (1962 feet/s [ft/s]) in two minutes. The material heatshiel to be used for the forebody heatshiel is Phenolic Impregnated Ceramic Ablator (PICA), recently developed at NASA's Ames Research Center. Due to friction, the

peak heating would occur at approximately 54 seconds after reentry begins, which corresponds to an altitude of approximately 60 km (196,860 ft) above the earth. The ablation would continue for about twenty seconds. Models conservatively predict that less than 22 percent of the total PICA material would ablate during reentry, and that ablation would cease at approximately 46.5 km (152,566 ft) above the earth. The total mass of the PICA material would be about 8.5 kg (18.7 pounds [lb]); of this, a maximum of 1.86 kg (4.09 lb) would be ablated during reentry. The chemical species produced during ablation would be dissipated in the shock wave behind the SRC. Two of the chemical species produced in small amounts during ablation, hydrogen cyanide and cyanide (37 grams [g] and 149 g, respectively), are considered to be acutely toxic to humans when inhaled. The ablation process and thus the production of these species would cease more than 46 km (150,000 ft) above the earth. Therefore, these concentrations would disperse in the large volume of air in the upper atmosphere and would not constitute a danger to health or life on earth. The SRC heatshiel would be rapidly cooling during the subsonic portion of the descent, and would not be emitting into the lower atmosphere.

UTTR is primarily used by the U.S. Air Force as a bombing and artillery test and training range. The entry, descent, landing, and recovery operations for the 42.6 kilogram (93.7 lb) SRC would be well within the bounds of the day-to-day operations carried on at UTTR. There would be no impact on threatened or endangered species or critical habitat, cultural resources, wetlands or floodplains at UTTR. Off-nominal recovery scenarios have also been addressed. No other impacts of potential environmental concern have been identified.

On the basis of the Stardust EA, NASA has determined that the environmental impacts associated with the mission would not individually or cumulatively have a significant impact on the quality of the human environment. NASA will take no final action prior to the expiration of the 30-day comment period.

Earle K. Huckins III,

Deputy Associate Administrator for Space Science.

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