SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

1.0 PURPOSE AND NEED FOR ACTION

1.1 BACKGROUND

In July 1995, NASA completed and made available to the public and other interested parties, the Final Environmental Impact Statement, dated June 1995, for the Cassini mission to Saturn (hereinafter, denoted 1995 Cassini EIS) (NASA 1995). This was followed in October 1995 by the Record of Decision (Appendix A), in which NASA chose to implement the Proposed Action. Specifically, NASA chose to continue preparations for and implement the Cassini mission to collect scientific data from Saturn, its atmosphere, moons, rings and magnetosphere. The mission would be launched from Cape Canaveral Air Station (CCAS), onboard a Titan IV (SRMU or SRM)/Centaur at the primary launch opportunity from October 6 through November 15, 1997, and inserted into a Venus-Venus-Earth-Jupiter-Gravity-Assist (VVEJGA) trajectory to Saturn. A secondary opportunity exists from November 27, 1997 through January 9, 1998, with a backup opportunity from mid-March to early April 1999, both using a Titan IV (SRMU or SRM)/Centaur launch vehicle and a Venus-Earth-Earth-Gravity-Assist (VEEGA) trajectory.

The Cassini spacecraft incorporates three (3) Radioisotope Thermoelectric Generators (RTGs) to provide onboard electric power for spacecraft operation and scientific instruments. The RTGs generate electric power by utilizing the heat from decay of radioactive material. The material is an isotopic mixture of plutonium in the form of dioxide (to be referred to as plutonium dioxide, or PuO_2) along with small amounts of long-lived actinides and other impurities. About 71 percent of the mixture (by weight) is plutonium-238. The three RTGs onboard the Cassini spacecraft contain a total of 32.7 kg (about 72 lb) of PuO_2, amounting to 1.49×10^{16} Becquerels (Bq) (402,000 curies [Ci]). In addition, 129 Radioisotope Heater Units (RHUs) will be employed to regulate the temperature for several instruments and inside the spacecraft. Each RHU contains about 2.7 gm (0.006 lb) of mostly plutonium-238 dioxide, amounting to a total of about 0.35 kg (0.77 lb), or about 1.48×10^{14} Bq (4,000 Ci) of radioactive material in 129 RHUs.

The EIS analyses indicated that continuing preparations for and implementing a normal Cassini mission would not adversely impact the human environment. The 1995 Cassini EIS determined that only in the event of an accident resulting in a release of plutonium dioxide was there any potential for substantial impacts to the human environment.

In evaluating the potential impacts associated with accidents for the 1995 Cassini EIS, NASA and its cooperating agency, the U.S. Department of Energy (DOE), using the best information available at that time, developed an array of four representative launch accident scenarios and the resulting accident environments. Accident scenarios identify the physical events that occur as a result of launch failures and the associated probabilities of occurrence. Accident environments describe the various forces which impinge upon the RTGs. The four scenarios were representative of accidents that could potentially occur across all launch phases and could lead to a release of PuO_2. Accident scenarios and associated environments were also evaluated for an inadvertent reentry of the spacecraft into the atmosphere during an Earth swingby maneuver of the gravity-assist trajectory.

The four launch accident scenarios were evaluated across launch Phase 1 (Phase 1 is initiated at T minus zero seconds [T-0 s], with ignition of the SRMUs at the launch pad), through launch Phase 6 (insertion of the spacecraft into the planetary gravity-assist trajectory). No pre-launch Phase 0 accidents were identified that could cause a credible release. (For additional details regarding the accident scenarios and environments and the initiating probabilities, see Sections 4.1.5 and 4.1.6, respectively, of the Cassini EIS.) Releases from the RHUs were not considered significant when compared to potential releases from the RTGs.

NASA and DOE analyzed the representative accident scenarios with respect to the consequences and risks to human health (defined as excess latent cancer fatalities over a 50-year period, beyond those normally expected to occur, within the exposed population) and the environment. The results of those analyses were presented in Section 4.1 of the 1995 Cassini EIS. The 1995 Cassini EIS estimated the risk within each launch phase and for the Earth gravity-assist swingby to potentially affected human populations, as well as the overall mission risk (i.e., across all launch phases, including the Earth gravity-assist), to be small.

The 1995 Cassini EIS also indicated that NASA, DOE and the U.S. Air Force (USAF) were continuing to conduct mission safety analyses to determine the potential for release of PuO_2 in the event of an accident and the associated consequences and risks. In view of the ongoing mission analyses, NASA made a commitment in the 1995 Cassini EIS (see Section 4.6--Incomplete or Unavailable Information, item 2) and in the ROD (Appendix A). Specifically, this commitment noted that if the ongoing investigations resulted in risk greater than those presented in the 1995 Cassini EIS, NASA would evaluate the information and make a determination regarding preparation of additional NEPA documentation.

Results recently made available from the updated analyses are more refined and comprehensive than those in the 1995 Cassini EIS. Refined probabilistic risk assessment techniques, similar to those used for the Galileo and Ulysses missions, were used to assess the full range of accident scenarios and environments (including the four representative accident initiating events considered in the 1995 Cassini EIS) that could occur during launch of the spacecraft, as well as an inadvertent reentry during Earth swingby. The refined techniques used by the ongoing analyses specifically estimate the response of the Cassini RTGs and RHUs to the environments associated with each accident scenario possible for the Cassini mission. This SEIS provides the results of the updated analyses. As discussed in Chapters 2 and 4, while the overall best estimate of risk has not changed appreciably for the mission, the variability in the updated analyses' results for individual mission segment accidents has prompted NASA's preparation of this SEIS.

1.2 PURPOSE OF THE PROPOSED ACTION

NASA, in an international cooperative effort with the European Space Agency (ESA) and the Italian Space Agency (ASI), proposes to conduct an extended investigation of the Saturnian system. The Cassini spacecraft would tour and study Saturn, its rings, moons and magnetosphere over a four-year period. Saturn is the second-largest and second-most massive planet in the solar system and has the largest, most visible, dynamic ring structure of all the planets. The mission is an important part of NASA's program for exploration of the solar system, the goal of which is to understand the system's birth and evolution. The Cassini mission involves a four-year scientific exploration of Saturn, its atmosphere, moons, rings and magnetosphere. The Cassini spacecraft consists of the Cassini Orbiter and the detachable Huygens Probe.

For several months, prior to its arrival at Saturn in July 2004, the spacecraft would perform scientific observations of the planet. The planned arrival date at Saturn provides a unique opportunity to have a distant flyby of Saturn's outer satellite, Phoebe. As the spacecraft maneuvers into its Saturn orbit, it will be at its closest distance to the planet during the entire mission. This offers a unique opportunity to observe the inner regions of Saturn's ring system and magnetosphere. About three weeks before Cassini's first flyby of Titan, Saturn's largest moon, the Huygens Probe would be deployed on its trajectory for later descent into Titan's atmosphere. The Probe would sample and determine the composition of Titan's atmosphere during its 2.5 hour descent and gather data on the moon's landscape. The Cassini Orbiter would then continue its tour of Saturn's system, making about 72 orbits of the planet over four years. The Orbiter would have about 35 encounters with Titan, about 6 encounters with icy moons of high interest such as Enceladus and Iapetus, and many more distant flybys of Saturn's other moons. The scientific information gathered by the Cassini mission could help provide clues to the evolution of the solar system and the origin of life on Earth.

For details of the goals and specific scientific observations that will be made by the Cassini Orbiter and the Huygens Probe, refer to Section 1.2 of the 1995 Cassini EIS.

1.3 NEED FOR THE ACTION

As stated in the 1995 Cassini EIS, conduct of the Cassini mission represents an important step in the exploratory phase of interplanetary science, with the detailed data that would be obtained from the mission providing an important basis for continuing Earth-based studies. Implementation of the proposed action would also ensure that the spacecraft would complete its orbital tour before 2010, when Saturn's rings would present themselves nearly edge-on to the Earth and Sun, severely limiting the ability for detailed observations. Additional details regarding the need for action can be found in Section 1.3 of the 1995 Cassini EIS.

1.4 RESULTS OF PUBLIC REVIEW OF THE DRAFT SEIS

NASA published its Notice of Availability (NOA) for the Draft SEIS in the Federal Register on April 9, 1997 (62 Federal Register 17216), and mailed copies of the Draft SEIS and the supporting HNUS document to over 130 Federal, State and local agencies, organizations, and individuals. The U.S. Environmental Protection Agency (EPA) published its Notice of Availability in the Federal Register on April 11, 1997 (62 Federal Register 17810), initiating the 45-day review and comment period. Additional requests for the Draft SEIS and the supporting HNUS documentation subsequent to publication of the EPA NOA raised the total number of copies distributed to over 150.

The comment period for the Draft SEIS closed on May 27, 1997. A total of 16 response letters were received - 3 from Federal agencies, 12 from private individuals, and 1 from an organization. The comments ranged from “no comments” and questions regarding the ability of the RTGs and RHUs to survive reentry conditions; to questions regarding use of solar power, and emergency response planning.

Cassini Mission
Final Supplemental Environmental Impact Statement