RECORD OF DECISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Final Supplemental Environmental Impact Statement for Sounding Rockets Program

A. BACKGROUND

The purpose and need for this action is to update the Final Environmental Impact Statement (FEIS) which was prepared for the NASA Sounding Rockets Program (SRP) in July 1973. The NASA SRP supports space and Earth sciences research sponsored by NASA and other users by providing suborbital vehicles for deployment of scientific payloads. The Proposed Action presented in the Final Supplemental Environmental Impact Statement (FSEIS) is to continue SRP activity in the present form and at the current level of effort. The Proposed Action does not contemplate any significant change in programmatic scope, or site-specific elements of the program. Consequently, no change in current environmental or interrelated socioeconomic impacts is anticipated from the continuation of the SRP.

The FSEIS reflects programmatic and site-specific changes in the NASA SRP that have taken place since 1973. This includes deleting launch vehicles that are no longer used; adding new launch vehicles and systems currently being used; reflecting changes in Federal and State environmental statutes and regulations; and updating changes in launch sites and ground support activities.

The NASA SRP is a suborbital spaceflight program primarily in support of space and Earth sciences research activities sponsored by NASA. This program also provides applicable support to other government agencies, as well as international sounding rocket groups and scientists. The program is a relatively low-cost, quick response effort. These experiments provide a variety of information, including high-altitude wind shear and velocity, density and temperature of particles in the upper atmosphere, and changes in the ionosphere. Sounding rocket payloads also yield valuable data on the natural conditions surrounding the Earth, Sun, stars, galaxies, nebulas, planets, and other phenomena. The environmental studies dealing with ozone depletion and global warming are only a few examples of scientific programs carried out by the NASA SRP for the protection of planet Earth.

NASA uses sounding rockets to allow scientists to conduct investigations at specified times and altitudes. Sounding rockets fly vertical flight trajectories from 48 kilometers (30 miles) to over 1,290 kilometers (800 miles) in altitude. Sounding rockets provide the only means for in-situ measurements at altitudes between the maximum altitude of balloons (about 48 kilometers or 30 miles) and the minimum altitude for satellites (about 160 kilometers or 100 miles). The flight normally lasts less than 30 minutes. All of the motors used in the program use solid fuel and are relatively small.

B. INTRODUCTION TO THE ENVIRONMENTAL IMPACT STATEMENT (EIS)

This FSEIS was developed to address: (1) the programmatic environmental impact of the SRP; and (2) the site-specific environmental impacts at, and in the area of, the three principal domestic sounding rocket sites: Wallops Flight Facility (WFF), Wallops Island,Virginia; Poker Flat Research Range (PFRR) near Fairbanks, Alaska; and White Sands Missile Range (WSMR),White Sands, New Mexico.

Some sounding rocket campaigns are conducted at other U.S. sites and at foreign locations. Prior to deciding whether to conduct sounding rocket campaigns at sites other than the three specifically addressed in the FSEIS, NASA will undertake additional site-specific environmental review and documentation, as appropriate.

Comments on the Draft Supplemental EIS (DSEIS) were solicited from federal, state and local agencies, organizations, and the general public through notices published in the Federal Register: NASA notice on June 12, 1995 (60 FR 30901), and U.S. Environmental Protection Agency notice on June 16, 1995 (60 FR 31716). Newspaper advertisements ran in the Virginia Eastern Shore News, the Fairbanks (Alaska) Daily News, and the Alamogordo (New Mexico) Daily News. There was also a concurrent mailing of the document to 194 federal, state, and local agencies, organizations, and members of the general public. Twenty-three written comment letters were received from the public comment period. These comments dealt with a range of issues, including: concern over the endangered White Sands Pupfish; concern about interruption of radio telescope signals; request for additional detail regarding spent rocket recovery procedures and site maps; lack of Environmental Justice data; upgraded WSMR data; and the need to follow erosion and sediment control and storm water management plans.

On May 1, 1996, the DSEIS was re-mailed to 35 Alaska addressees via certified mail after NASA was notified that they had not received their comment copies. As a result of this mailing, two comments were received from Alaska: (1) PFRR thanked NASA for the review opportunity and had no recommendations; (2) the U. S. Department of Agriculture, Natural Resources Conservation Service indicated no impact.

The FSEIS was made available on February 18, 2000, and the waiting period expired on March 20, 2000. Nine comment letters were received. These letters identified two typographical errors, and recommended additional mitigation measures concerning archaeological resources. NASA has responded directly to these comments. Mitigation measure commitments are presented in this Record of Decision (ROD).

Alternatives Considered

The alternatives addressed in the FSEIS were:

(1) Continue the SRP in its present form and at the current level of effort. This Proposed Action does not contemplate any significant change in programmatic scope, or site-specific elements of the program. Consequently, no change in current environmental or interrelated socioeconomic impacts is anticipated from the continuation of the SRP; and (2) The No-Action alternative, termination of the NASA SRP, consists of the cessation of the launching of the various vehicles with their payloads from the three principal launch sites or from any other launch site. This alternative will result in overall negative scientific and economical consequences, and reduce progress in our understanding of the Earth's environment. However, minor environmental impacts associated with rocket launches associated with SRP would be avoided.

Programmatic alternatives to the Proposed Action and site-specific alternatives:

Programmatic: Include alternatives to sounding rockets that could accomplish the aims of the Space Science Exploration Program and launching sounding rockets with alternative propellants. Major issues regarding alternatives to sounding rockets include the area of plasma physics where all alternatives considered are unsuitable or produce data of lower quality. It can be deduced from the nature of scientific inquiry in other disciplines that observations from the ground, aircraft, and balloons result in a reduced quality of the scientific data collected in some instances, and total inability to conduct experiments in other instances. The use of the Space Transportation System (STS), satellites, and space probes meet the program objectives in some instances; however, such high technology vehicles are not always available or cost effective for the low-cost science projects, such as those being supported by the SRP. Also, some of the SRP payloads are not allowed to be flown on STS. Furthermore, the propulsion systems used to lift the STS, satellites, and space probes are considerably larger and more complex than required by the missions flown on sounding rockets. Most of the alternatives do not provide a practical and satisfactory means for conducting scientific research in the indicated disciplines. No alternative to the sounding rocket could provide the same quality of scientific data.

The use of alternative solid propellants was also considered under this FSEIS. The propellant systems currently used by the NASA SRP are based either on an ammonium perchlorate (AP)/aluminum (Al) combination, or a nitrocellulose (NC)/nitroglycerin (NG) combination. The emissions from the AP/Al propellant combination include hydrogen chloride and aluminum oxide, and are generally considered to be more environmentally damaging than emissions from the NC/NG propellant combinations. NASA has carried out an extensive operational and environmental evaluation of the replacement propellants for the AP/Al propellant combination. Several alternatives were considered and evaluated, including ammonium nitrate (AN). It was determined that AN propellant is low in performance and would generate emissions of other pollutants, such as nitrogen oxides and nitric acid. Other propellants considered by NASA included

cyclotetramethylene tetranitramine (HMX). This alternative was also rejected as impractical, because HMX is highly explosive and is rated as a detonating compound. Alternative propellants are impractical since they would result in decreased performance, generate other pollutants, or present other physical dangers.

Site-Specific: Sounding rocket vehicles consist of small rockets that move in suborbital trajectories. They require launchers (e.g., of the rail or tube type) and present some environmental risks at takeoff. Therefore, rocket launch sites and associated support facilities of some complexity are needed. These sites are permanent where repeated launches take place year after year. Currently, NASA uses the three fully equipped permanent sounding rocket launch sites at WFF, PFRR, and WSMR. There are no proposals at this time for construction of additional permanent launch facilities for the NASA SRP. Building of new and different permanent facilities would increase environmental stress due to construction activities without providing any known operational or environmental advantages.

Key Environmental Issues Evaluated

The most important and relevant programmatic environmental issues with respect to continuation of the SRP are upper and lower atmosphere emissions; noise; landing and recovery operations; and risk to human life and property. Depending on the specific launch site involved, other issues, such as impacts to wildlife and threatened and endangered species, wetlands, and water quality, may be important. All potential environmental effects were evaluated in accordance with the National Environmental Policy Act of 1969, as amended (42 U.S. C. 4321 et seq.), the Council on Environmental Quality regulations for implementing the procedural provisions of the National Environmental Policy Act (40 CFR Parts1500-1508), and NASA policy and procedures (14 CFR Part 1216, Subpart 1216.3).

Environmental Consequences of the Alternatives

Programmatic impacts of the NASA SRP include environmental impacts on the Earth's upper and lower atmosphere, as well as impacts due to noise and landing and recovery operations. The highest altitudes for SRP emissions are in the hundreds of kilometers where chemical releases from some payloads take place. At lower levels, there are emissions from the exhausts of SRP upper stage rockets and attitude control systems. The releases of chemicals and attitude control systems fluid/gases in the upper atmosphere are associated with scientific missions. The emissions of rocket exhaust products are associated with the operation of the launch vehicles.

Analysis of a 10-year SRP activity indicates 31 flights each year with mass of chemical release varying from 5 to 272.2 kilograms (11.24 to 600.2 pounds) per flight, with an average of 43.4 kilograms (95.7 pounds) per flight. The 10-year total mass of released chemicals was 1344.6 kilograms (2,964.8 pounds), for an annual average of 134.5 kilograms (296.6 pounds). The release of a given chemical in the upper atmosphere is

usually made to enhance a specific scientific observation. Some of these chemicals are classified as hazardous; however, the quantities of chemicals released and the negative impacts of such releases are small and can be best addressed in an operational sense.

Typical upper stage rocket exhaust emissions from the NASA SRP vehicles include hydrogen chloride, aluminum oxide, carbon monoxide, carbon dioxide, hydrogen, water, trace metals, and small quantities of other chemicals. The emissions of 13 of the 15 launch vehicles are essentially confined to the stratosphere. Only Black Brant X and XII vehicles emit in the ionosphere. The emissions occur as line sources along trajectory arcs.

Noise generated by the suborbital SRP flights can be grouped into launch noise, flight noise, and landing noise. The SRP flights follow ballistic trajectories modified by air resistance. The landing speeds of these objects are supersonic, similar to those of artillery shells and missiles, which enter the atmosphere at directions not far from the vertical. Therefore, the sonic booms associated with supersonic flight of aerodynamic bodies flying horizontally or at small angles to the horizontal are absent in the SRP.

All metallic and other solid, heavier-than-air objects, which are propelled into the atmosphere by the launch vehicles return to Earth in more or less ballistic trajectories. The objects include spent rockets, payloads, nose cone doors, and despin weights. In multistage SRP launch vehicles, the first stage or launch rocket invariably flies a very short trajectory following a burn time of only a few seconds. The impact ranges for the first stage of all multistage vehicles are shown to be less than 1.5 kilometers (1 mile), with some as small as 0.3 kilometer (0.2 miles). Spent rocket impact weights are in the 270- to 800-kilogram (595.4 to 1,764 pounds) range.

The spent second stage in a three-stage launch vehicle has an impact range from 5 to 25 kilometers (3 to 15 miles). The impact range varies with selected payload weight and launch angle. The impact ranges for the spent weather, ozone, and 70-millimeter test rockets are from 2.8 to 5.5 kilometers (2 to 3 miles). Rocket motors that impact hundreds of kilometers or more down range are limited to vast uninhabited areas. Normally, no recovery is attempted. Without additional disturbance, natural processes eventually obliterate the location of the impact.

While spent rockets are usually not recovered, most payloads are recovered for data extraction, inspection, refurbishing and prospective reuse. This is normally done by separating the payload from the final stage and then deploying a parachute at about a 6 kilometers (3.7 miles) altitude. As a result, the payload decelerates and floats down in a direction determined by local wind conditions. The payload is located by aircraft. At WSMR, a good-faith attempt is made to recover all rocket debris.

All NASA SRP missions are required to contain both Ground and Flight Safety Plans to minimize risk to human life, property, and natural resources. Impact and overflight criteria are considered in the Flight Safety Plans and, while risk cannot be entirely eliminated, it is reduced to a very small and acceptable level.

Impacts to land, wetlands, and floodplains of the WSMR stem from the actual impact of launch vehicles and payloads, and may result from recovery efforts. The first stage of the launch vehicle impact occurs relatively close to the launch facilities. This is evidenced by several launch vehicles found partially buried, nose down, a few hundred meters from the launch facility. Such impacts do not appear to materially affect the surrounding habitat.

Endangered and threatened species are present at WFF, PFRR, and WSMR. Consultations with the U.S. Fish and Wildlife Service, and state, as well as site operators, revealed a number of concerns regarding protection of these species. Appropriate corrective actions were taken by NASA WFF at Wallops Island in cooperation with the Fish and Wildlife Service. Restrictions on activities on the southern and northern parts of Wallops Island during the piping plover nesting season have been implemented. In order to protect pupfish habitat at WSMR, the U.S. Navy, which is responsible for NASA SRP operations at WSMR, has instituted mitigation procedures that are described under Section E (Mitigation) of this document.

Based on an environmental justice evaluation, it was determined that federal actions conducted at WFF, WSMR, and PFRR do not disproportionately or adversely affect minority or low-income populations. In addition, no impacts to identified cultural resources are predicted as a result of the SRP.

Termination of SRP activity would result in the elimination of minor and transient environmental impacts of the sounding rocket launches. The reduction in emissions of carbon dioxide, carbon monoxide, aluminum oxide, hydrogen chloride, metals, and other chemical will be approximately 39 metric tons annually. The overall reduction in use of materials and energy due to termination of the SRP is small.

Termination of the sounding rocket launches would result in a reduction or elimination of a number of atmospheric environmental research studies. Some of these studies deal with ozone depletion and green house atmospheric effects, as well as research in plasma physics, ultraviolet and X-ray astrophysics, solar physics, and Earth's upper atmosphere. The termination of the SRP will have an adverse impact on local economies, especially in the area of the Eastern Shore of Virginia, where WFF makes a substantial contribution to the local economy.

C. ASSESSMENT OF THE ANALYSIS

While the introduction of any chemical, including water and carbon dioxide, has some impact on the chemistry of the upper atmosphere, those that are introduced by the SRP are in relatively small quantities in the stratosphere, and even smaller in the ionosphere and can be considered to be not substantial. The program uses relatively minute amounts of fuel in the form of propellants. Consequently, little if any contribution to global climate change occurs as a result of emissions from this program. The quantity of chlorine released in the upper atmosphere is very small and produces little, if any, impact

on stratospheric ozone. The SRP generates relatively small amounts of air emissions, and no substantial pollution effects in the lower atmosphere are expected from this program.

Launch noise persists for a few seconds. The unprotected public at 11 kilometers (6.8 miles) would be exposed to a noise lower than a diesel truck that generates 85 dBA from 15 meters (50 feet) distance when travelling at 64 kilometers per hour (40 miles per hour). Unless humans or animals are in the immediate vicinity of a landing ballistic, spent rocket, or payload, noise is not a problem.

Based on worldwide experience to date, the landing impacts due to SRP launches have been safely minimized without incident. From 1959 to the present time, over 2,600 launch vehicles have been flown in the SRP. As evidence of the effectiveness of the precautions observed, no casualties, injuries, or property damage are known to have resulted from the landing impacts of the spent rockets, payloads, or fragments. Impact and overflight criteria are considered in the Flight Safety Plans. While risks cannot be entirely eliminated, they are reduced to a very small likelihood and are acceptable.

The SRP adheres to all special considerations for minimizing and/or preventing impacts on endangered and threatened species.

The programmatic environmental impacts of the SRP are not significant. The cumulative programmatic and site-specific environmental impacts associated with conducting the SRP at WFF, PFRR, and WSMR are not significant. However, it is conceivable that the combination of programmatic and site-specific impacts at another site could result in significant effects to the quality of the human environment. Therefore, additional environmental documentation, as appropriate, will be completed before final action is taken on SRP activities at sites other than WFF, PFRR, and WSMR.

Choice of Alternatives

In view of the small risks associated with continuation of the SRP in its present form and at the current level of effort, it is my intention to choose the Proposed Action, Alternative 1, based on the following:

The NASA SRP is a scientific endeavor designed to increase the depth of knowledge of near-space, the Earth's atmosphere, and outer space. The results of the scientific experiments are making substantial contributions to the protection of the environment without having a significant negative effect on the environment. The launch and recovery processes represent relatively minor transient effects.

Practical and cost-effective means for protecting the environment can be developed only on the basis of knowledge and understanding of the physical, chemical, and biological processes affecting such an environment. Scientifically, more has been learned about the immediate environment and that of the solar system in the last 2 decades than in all the previous decades combined. The NASA SRP makes unique contributions to the total

effort to provide an operational capability to measure and monitor environmental conditions and natural resources from a local to global scale.

The application of sounding rocket technology in studies dealing with ozone depletion in the upper atmosphere is one of the examples of the critical role the NASA SRP is playing in protecting our environment. In fulfilling its responsibility, the program has followed a philosophy that has emphasized safety and economy in conducting these experiments.

The continuation of the NASA SRP would result in irreversible and irretrievable commitment of small quantities of structural materials and propellants. Use of military surplus solid propellant rockets, such as Nike, Orion, Taurus, Terrier, and Aries, in the NASA SRP activities further reduces the commitment of new raw materials and provides for the beneficial use of already expended resources that might become hazardous waste. The quantities of physical resources used by the SRP are small. Consequently, the continuation of the NASA SRP will not commit expenditure of natural resources in substantial quantities.

Termination of the SRP would eliminate the small direct adverse environmental impacts of its implementation. Therefore, in one sense this alternative would be environmentally preferable. However, termination of the SRP would not satisfy the need and purpose of this program, which includes a better understanding of the Earth's environment.

D. ADDITIONAL INFORMATION

The regulations for implementing the procedural provisions of the National Environmental Policy Act (40 CFR 1502.25) state that, to the fullest extent possible, draft EIS's shall be prepared concurrently with, and integrated with, surveys and studies required by the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.), the National Historic Preservation Act 1966 (16 U.S.C. 470 et seq.), the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.), and other environmental review laws and executive orders.

Examination of available literature (existing site-specific EIS, environmental assessment, environmental resources document, biological, and archaeological/historical reports), face-to-face and telephone consultations, and correspondence with responsible regulatory agencies generated the information required for compliance with these requirements.

Extensive safety and technical reviews will continue to be conducted for all NASA SRP missions.

E. MITIGATION

Mitigation procedures committed to the NASA SRP are specified in Chapter 4.0 of the FSEIS and shall be implemented. In the normal launch of a sounding rocket, one or more spent rocket stages and often the payload will follow a ballistic trajectory and land, intact, in the ocean or an unpopulated land area. To avoid endangering, to any appreciable

extent, any person, property, or any living plant or animal species, the landing locations are carefully planned. Because the flightpath of sounding rockets is influenced by atmospheric winds, careful consideration is given to wind velocities before any launch. The impact areas are carefully selected. If it is an ocean area, ship traffic is advised so that there will be a minimal hazard to people or property aboard such vessels. Aircraft and radar surveillance is exercised over these areas when sounding rocket launches are planned. When payloads impact in the ocean, sometimes recovery is attempted. Spent rocket stages are usually not recovered. In the case of land areas, exclusion is practiced, and the areas are under surveillance during periods of activity. When spent stages or unrecovered payloads would impact on land, unoccupied areas are planned as landing sites.

In the WSMR desert area, only rangeland surface is disturbed. In northern areas such as PFRR, launches over land will cause impacts on tundra and subarctic evergreen forest. Because most rockets are fin stabilized, they impact nose down, and the surface disturbance will be minimal.

Current environmental protection policies at WSMR for the NASA SRP fully recognize the sensitivity of the White Sands pupfish habitat and have built-in mitigation to ensure no impact. After the launch is completed, the recovery team is transported via helicopters to locate the sustainer and payload. The sustainer is recovered by ground vehicles entering the desert single file from the nearest point of an existing road. The payload is recovered by helicopter; no ground vehicles are required for payload recovery. The worst case scenario, a direct hit on the species habitat of Salt Creek, would not harm the pupfish population unless it directly hit a pupfish. Of the more than 1,100 recorded rocket motor stage impacts since 1967, there have been no landings on Salt Creek. The probability of harming a pupfish is very low.

The FSEIS also states that in the event that previously undiscovered cultural resources are identified during the course of the SRP, NASA will take no action affecting the resources until the requirements of 36 CFR Part 800 (Protection of Historic Properties) are satisfied.

Based on worldwide experience to date, the landing impacts due to SRP launches have been safely minimized without incident. In my judgment, all practicable means to avoid or minimize harm from the selected alternative have been adopted and will be implemented.

Decision

Based upon all of the foregoing, it is my decision to programmatically continue the NASA SRP activity in its present form and at the current level of effort. Furthermore, it is my decision to continue NASA SRP activity at WFF, PFRR, and WSMR in its present form and current level of effort. This proposed action does not contemplate any significant change in programmatic scope, or site-specific elements of the program. I am confident that no change in current environmental or interrelated socioeconomic impacts will occur from the continuation of the NASA SRP.

Alan Burnes for

Edward J. Weiler
Associate Administrator for Space Science

6/30/00
Date