National Aeronautics and
Space Administration
Goddard Space Flight Center
Greenbelt, MD 20771

June 30, 2004

Reply to Attn of:
463

MEMORANDUM FOR THE RECORD

National Environmental Policy Act (NEPA) Compliance for Solar-Terrestrial Relations Observatory (STEREO)

1.0 Introduction

The NEPA of 1969, as amended (42 U.S.C. 4321, *et seq.*), requires Federal agencies to consider the environmental impacts of a project in their decision making process. To comply with NEPA and associated regulations (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 prepared an Environmental Assessment (EA) for routine payloads launched on Expendable Launch Vehicles (ELV's) from Cape Canaveral Air Force Station (CCAFS) and Vandenberg Air Force Base (VAFB) (Ref: *Final Environmental Assessment for Launch of NASA Routine Payloads on Expendable Launch Vehicles from Cape Canaveral Air Force Station, Florida, and Vandenberg Air Force Base, California*, June 2002). The EA assesses the environmental impacts of missions launched from CCAFS and VAFB with spacecraft that are considered routine payloads.

Spacecraft defined as routine payloads would utilize materials, quantities of materials, launch vehicles and operational characteristics that are consistent with normal and routine spacecraft preparation and flight activities at VAFB, CCAFS, and the Kennedy Space Center. The environmental impacts of launching routine payloads from VAFB and CCAFS fall within the range of routine, ongoing and previously documented impacts that have been determined not to be significant. Spacecraft covered by this EA meet specific criteria ensuring that the spacecraft, its operation and decommissioning, do not present any new or substantial environmental or safety concerns.

To determine the applicability of a routine payload classification for a mission launched from VAFB and CCAFS and coverage under the NASA routine payload EA, the mission is evaluated against the criteria defined in the EA using the Routine Payload Checklist (RPC).

2.0 Mission Description

The primary goal of the STEREO Mission is to advance the understanding of the three-dimensional structure of the Sun's corona, especially regarding the origin of coronal mass ejections (CME's), their evolution in the interplanetary medium, and the dynamic coupling between CME's and the Earth's environment. CME's are the most energetic eruptions on the Sun, are the primary cause of major geomagnetic storms, and are believed to be responsible for the largest solar energetic particle events. CME's may also be a critical element in the operation of the solar dynamo, because they appear to remove dynamo-generated magnetic flux from the Sun.

The STEREO Mission will be accomplished through the use of two spacecraft orbiting the Sun at a radius of one astronomical unit, one drifting ahead of the Earth and one behind. Simultaneous extreme ultra-violet (EUV) and visible image pairs along with simultaneous measurements of fields and particles will be obtained by STEREO at gradually increasing angular separations in the course of the mission.

The STEREO spacecraft are outfitted with two instrument suites and two instruments: the In-situ Measurements of Particles and CME Transients (IMPACT) managed by University of California, Berkeley (UCB); the Sun-Earth Connection Coronal and Heliospheric Investigation (SECCHI) managed by Naval Research Laboratory (NRL); the Plasma and Suprathermal Ion Composition (PLASTIC) managed by the University of New Hampshire (UNH)); and STEREO/waves (SWAVES) managed by Observatoire de Paris-Meudon with Goddard Space Flight Center as lead U.S. Co-Investigator and the University of Minnesota (UMN) as the U.S. Project Manager. The two STEREO spacecraft are being managed, designed, and fabricated by the Johns Hopkins University Applied Physics Laboratory (JHU/APL). Communications between the ground and spacecraft will be accomplished through the use of the NASA Deep Space Network (DSN). The STEREO Science Center (SSC) will perform instrument commanding functions and capture, extract and archive STEREO science data

The two STEREO spacecraft will be launched on the same DELTA II launch vehicle from CCAFS in the 1st Quarter 2006. Both spacecraft will enter into a heliocentric orbit and will not return to earth. The spacecraft bus consists of six operational subsystems supporting the two instruments and two instrument suites. This combination provides a total of 16 instruments per observatory. The subsystems include: command and data handling; radio frequency communications; guidance and control; propulsion; power; and thermal. The spacecraft are solar-powered, 3-axis-stabilized, each with a launch mass – including propellant – of approximately 620 kilograms (1,364 pounds).

The components utilized in the STEREO spacecrafts and instruments are made of materials normally encountered in the space industry. STEREO does not use any lasers. STEREO does not carry any pathogenic organisms, nor will STEREO return samples to Earth. STEREO does utilize small radioactive sources for calibration of the Super-Thermal Electron (STE) instrument on the In-situ Measurements of Particle And CME Transients (IMPACT) suite. Based on the A_2 Mission Multiple for these sources, the

nuclear launch approval requirement is at the Nuclear Flight Safety Assurance Manager level only. The A_2 Mission Multiple is a normalized value to identify the potential radiological risk of isotopes contained in a mission. The A_2 Mission Multiple determines the level of safety review necessary based on radiological risk. Materials/hazards associated with STEREO do not raise any substantial environmental or health (safety) concerns.

3.0 NASA Routine Payload Determination

The STEREO mission has been evaluated against the NASA routine payload EA for launches from CCAFS and VAFB, using the RPC (see enclosed Evaluation Recommendation Package). The evaluation indicates that the mission meets the criteria for a routine payload. The amount of radioactive material does not require approval at the NASA's Associate Administrator level or higher and thus falls within the routine payload envelope. The mission does not present any unique or unusual circumstances that could result in new or substantial environmental impacts. Based on this review, it is determined that the STEREO mission qualifies as a routine payload and falls within the scope of the reference routine payload EA. No additional NEPA action or documentation is required.

W. F. Townsend

for A. V. Diaz

Enclosure

EVALUATION RECOMMENDATION PACKAGE

Record of Environmental Consideration
Routine Payload Checklist
NEPA Environmental Checklist

Enclosure

RECORD OF ENVIRONMENTAL CONSIDERATION

1. Project Name: **Solar-Terrestrial Relations Observatory (STEREO)**

2. Description/location of proposed action:
The STEREO mission consists of two, three axis stabilized spacecraft with visible and UV telescopes, a magnetometer, a radio receiver with three antennas, and various electron and ion particle experiments. The spacecrafts will be launched on a DELTA II from CCAFS.

Date and/or Duration of project: Launch 1st Q 2006

3. It has been determined that the above action:

X a. Is adequately covered in an existing EA or EIS.
Title: *Final Environmental Assessment for Launch of NASA Routine Payloads on ELVs from CCAFS, Florida and VAFB, California*
Date: June 2002

___ b. Qualifies for Categorical Exclusion and has no special circumstances which would suggest a need for and Environmental Assessment.
Categorical Exclusion: _____

___ c. Is exempt from NEPA requirements under the provisions of:
_____

___ d. Is covered under EO 12114, not NEPA.
_____

___ e. Has no significant environmental impacts as indicated by the results of an environmental checklist and/or detailed environmental analysis.
(Attach checklist or analysis as applicable)

___ f. Will require the preparation of an Environmental Assessment.

___ g. Will require the preparation of an Environmental Impact Statement.

___ h. Is not federalized sufficiently to qualify as a major federal action.

Beth McKenney — 6/16/04
NEPA Coordinator, Code 250 — Date

Nick Chrissotimos — 6/21/04
Nick Chrissotimos, Code 463 — Date

NASA Routine Payload Checklist (1 of 2)

PROJECT NAME: **STEREO** DATE OF LAUNCH: November 15, 2005

PROJECT CONTACT: Nicholas Chrissotimos PHONE NUMBER: (301) 286-9125 MAILSTOP: 463

PROJECT START DATE: October 1999 PROJECT LOCATION: Goddard Space Flight Center, Greenbelt, MD 20771

PROJECT DESCRIPTION: Two identical heliocentric orbiting spacecraft leading and lagging the Earth taking stereoscopic images of the Sun as well as making in-situ particle and field measurements

A. SAMPLE RETURN:	YES	NO
1. Would the candidate mission return a sample from an extraterrestrial body?		X
B. RADIOACTIVE SOURCES:	**YES**	**NO**
1. Would the candidate spacecraft carry radioactive materials?	X	
2. If Yes, would the amount of radioactive sources require launch approval at the NASA Associate Administrator level or higher according to NPG 8715.3 (NASA Safety Manual)? Calculation by Ted Simmons Code 250.9 A_2 = 2.5E-6		X
Provide a copy of the Radioactive Materials Report as per NPG 8715.3 Section 5.5.2.		
C. LAUNCH AND LAUNCH VEHICLES:	**YES**	**NO**
1. Would the candidate spacecraft be launched using a launch vehicle/launch complex combination other than those indicated in Table 1 below?		X
2. Would the proposed mission cause the annual launch rate for a particular launch vehicle to exceed the launch rate approved or permitted for the affected launch site?		X
Comments:		
D. FACILITIES:	**YES**	**NO**
1. Would the candidate mission require the construction of any new facilities or substantial modification of existing facilities?		X
2. If Yes, has the facility to be modified been listed as eligible or listed as historically significant?		
Provide a brief description of the construction or modification required:		
E. HEALTH AND SAFETY:	**YES**	**NO**
1. Would the candidate spacecraft utilize any hazardous propellants, batteries, ordnance, radio frequency transmitter power, or other subsystem components in quantities or levels exceeding the Envelope Payload characteristics (EPCs) in Table 2 below?		X
2. Would the candidate spacecraft utilize any potentially hazardous material as part of a flight system whose type or amount precludes acquisition of the necessary permits prior to its use or is not included within the definition of the Envelope Payload (EP)?		X
3. Would the candidate mission release material other than propulsion system exhaust or inert gases into the Earth's atmosphere or space?		X
4. Would launch of the candidate spacecraft suggest the potential for any substantial impact on public health and safety?		X
5. Would the candidate spacecraft utilize a laser system that does not meet the requirements for safe operation (ANSI Z136.1-2000 and ANSI Z136.6-2000)? For Class III-B and IV laser operations, provide a copy of the hazard evaluation and written safety precautions (NPG 8715.3).		X
6. Would the candidate spacecraft contain pathogenic microorganisms (including bacteria, protozoa, and viruses) which can produce disease or toxins hazardous to human health?		X

Comments:

continued on next page

NASA Routine Payload Checklist (2 of 2)

PROJECT NAME: **STEREO** DATE OF LAUNCH: November 15, 2005

PROJECT CONTACT: Nicholas Chrissotimos PHONE NUMBER: (301) 286-9125 MAILSTOP: 463

PROJECT START DATE: October 1999 PROJECT LOCATION: Goddard Space Flight Center, Greenbelt, MD 20771

PROJECT DESCRIPTION: Two identical heliocentric orbiting spacecraft leading and lagging the Earth taking remote stereoscopic images of the Sun as well as making in-situ particle and field measurements

F. OTHER ENVIRONMENTAL ISSUES:	YES	NO
1. Would the candidate spacecraft have the potential for substantial effects on the environment outside the United States?		X
2. Would launch and operation of the candidate spacecraft have the potential to create substantial public controversy related to environmental issues?		X
Comments:		

Table 1: Launch Vehicles and Launch Pads

Launch Vehicle	Eastern Range (CCAFS Launch Complexes)	Western Range (VAFB Space Launch Complexes)
Atlas IIA & AS	LC-36	SLC-3
Atlas IIIA & B	LC-36	SLC-3
Atlas V Family	LC-41	SLC-3
Delta II Family	LC-17	SLC-2
Delta III	LC-17	N/A
Delta IV Family	LC-37	SLC-6
Athena I & II	LC-46 or -20	California Spaceport
Taurus	LC-46 0r -20	SLC-576E
Titan II	N/A	SLC-4W
Pegasus XL	CCAFS skidstrip KSC SLF	VAFB airfield

Table 2: Summary of Envelope Spacecraft Subsystems and Envelope Payload Characteristics (EPC)

Structure	**Unlimited:** aluminum, magnesium, carbon resin composites, and titanium **Limited:** beryllium [50 kg (110 lb)] **(STEREO: two s/c 857 kg dry total)**
Propulsion	Mono- and bipropellant fuel; 1000 kg (2200 lb) (hydrazine); 1000 kg (2200 lb) (monomethyhydrazine) Bipropellant oxidizer; 1200 kg (2640 lb) (nitrogen tetroxide) Ion-electric fuel; 500 kg (1100 lb) (Xenon) SRM; 600 kg (1320 lb) (AP)-based solid propellant **(STEREO: hydrazine 123.4 kg total for both s/c)**
Communications	Various 10-100 W (RF) transmitters **(STEREO: 60 Watt (RF) for each s/c)**
Power	Solar cells; 150 A-Hr (Ni-H_2) battery; 300 A-Hr (LiSOC) battery; 150 A-Hr (NiCd) battery **(STEREO: S-NiCd 21 Ampere Hours each s/c)**
Science instruments	10 kW radar **(STEREO: No Radar or Laser Systems)** ANSI safe lasers (Section 4.1.2.1.3)
Other	Class C EEDs for mechanical systems deployment Radioisotopes limited to quantities that are approved for launch by NASA Nuclear Flight Safety Assurance Manager **(STEREO: 1 μ Curie of Cd**

	109 and 1 μ Curie of Fe 55 for each s/c) Propulsion system exhaust and inert gas venting

NEPA Environmental Checklist

1. Project/Program

Solar-Terrestrial Relations Observatory (STEREO) Project Code 463
Solar Terrestrial Probes (STP) Program Code460

2. Points of Contact

Project Manager: Nick Chrissotimos Code: 463 Telephone: 6-9125
S/C Manager: Mark Jarosz Code: 463 Telephone: 6-8084
Instrument Manager: Mike Delmont Code: 463 Telephone: 6-1228
Other: Deputy Proj Manager: Jim Adams Code: 463 Telephone: 6-8320

3. Schedule

Formulation Process (Phase A/B): October 1999 – February 2002
Implementation Process (Phase C/D): February 2002 – January 2006
Launch Date: November 2005
Other Milestone Dates: Mission CDR (Feb/2003), Mission PSR (Aug/2005)

4. Current status

In C/D Phase and approximately 3 months behind schedule. Still planning to launch on schedule.

5. Project Description

a. Purpose/Need: is to advance the understanding of the three-dimensional structure of the Sun's corona, especially regarding the origin of the coronal mass ejections (CME) and their evolution in the interplanetary medium, and dynamic coupling between CMEs and the Earth environment.

b. Spacecraft/Instruments: Two, three axis stabilized spacecraft with visible and UV telescopes, a magnetometer, a radio receiver with three antennas, and various electron and ion particle experiments

c. Launch Vehicle: DELTA II 2925-10L
d. Launch Site: Cape Canaveral Air Station
e. Alternatives (to or for the mission): None

f. NASA's Involvement/Responsibility: Development of spacecraft and instruments as well as supplying launch vehicle

g. Participants/Locations: Goddard SpaceFlight Center, Greenbelt, MD, The Johns Hopkins University Applied Physics Laboratory, Laurel, MD; The University of California Berkeley, Berkeley, CA; Naval Research Laboratory, Washington, DC;

University of Minnesota, Minneapolis, MN; University of New Hampshire, Durham, NH; Observatorie de Paris, France

h. Mission Life: 2 yr with possible extension to five

i. End of mission, Re-entry: Both spacecraft will remain in heliocentric orbits

6. Is there anything controversial about the mission?

NO

7. Is there anything unique, unusual, exotic about the mission, spacecraft, and instruments?

This will be the first time that stereographic images of the Sun will be taken by two spacecraft

8. Is there any environmental documentation for spacecraft, launch vehicle (NEPA or EO12114)?

Expecting to use existing NEPA documentation; We believe that STEREO is in the envelope of requirements.

9. Is the mission compliant with NASA policy and guidelines for Orbital Debris? (NPD 8710.3 and NSS 1740.14)

YES

10. Has an Air Force Form 813 been completed? (Please attach copy)

Yes (must be revised for radioactive sources)

11. Does the mission include or involve:

Check all that apply. If uncertain indicate with a "?"
For all that apply provide an explanation. Use the additional space below if needed.

Yes a. Fuels

Yes b. Radioactive Material 1μCi of Cd 109 and 1μCi of Fe 55 on each spacecraft.

Yes c. Explosives

Yes d. Chemicals

____ e. Hazardous Materials/Substances

____ f. Lasers (Class, Earth Pointing)

____ g. Disease Producing Pathogenic Microorganisms

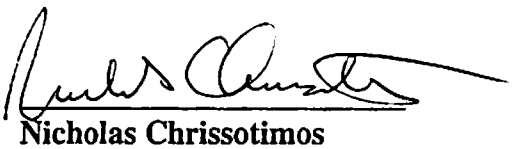
____ h. Construction/Modification of a Facility

Yes i. Discharges of any substances into air, water, or soil

Yes j. Generation/Use/Storage/Disposal of Toxic or Hazardous Substances
Yes k. Generation of Hazardous Wastes
Yes l. Generation of High Noise Levels
_____ m. Sample Return to Earth
_____ n. Generation of Ionizing or Nonionizing Radiation
_____ o. Impact on Local Social or Economic Conditions
_____ p. Removal of Vegetation or Destruction of Habitat
_____ q. Impact/Affect on Minority or Low Income Populations
_____ r. Affect Any Threatened or Endangered Species
_____ s. Affect Areas of Historical or Cultural Significance
_____ t. New or Foreign Launch Vehicle
_____ u. Other Issues of Potential Environmental Impact

12. What hazards are associated with the mission?

Use and handling launch vehicle and spacecraft fuels



6-21-2004

Nicholas Chrissotimos **Date**
Project Manager, Code 463

Explanations for Question 9.

a. Fuels – Solid rocket fuel, kerosene and liquid oxygen, nitrogen tetroxide and Aerozine for launch vehicle and 50 kilograms of Hydrazine in each spacecraft
b. Radioactive Materials – these minute sources will be used to calibrate some of the particle instruments in flight.
c. Explosives – Various bolt and wire cutters for deployment of devices on the spacecraft as well as bolt cutters used to separate the two spacecraft from the launch vehicle t
d. Chemicals – Various common solvents and chemicals used in electronics and optical projects; no chemicals carried in the spacecrafts
i. Discharges of any substances into air, water or soil – Launch vehicle exhaust is discharged into the air
j. Generation/Use/Storage/Disposal of Toxic or Hazardous Substances – Residue from printed wiring board fabrication and integrated circuit fabrication
k. See j
l. Generation of High Noise Levels – Launch vehicle on ascent