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

June 30, 2004

Reply to Attn of:
415

MEMORANDUM FOR THE RECORD

National Environmental Policy Act (NEPA) Compliance for Geostationary Operational Environmental Satellite (GOES) Project

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

GOES/ Polar Operational Environmental Satellite (POES) Program is a key element in National Weather Service (NWS) operations. The GOES/POES mission requires two

operational geostationary satellites and two operational polar orbiting satellites. These satellites operate in pairs. The geostationary satellites, GOES-East covering the East Coast and GOES-West covering the West Coast, provide real-time weather data for use in short-term weather forecasting (warnings of severe weather) and space environment monitoring, as well as research and development. The polar orbiting satellites primarily provide long-range weather forecasting, ensuring that non-visible data, for any region of the Earth, are no more than 6 hours old.

The GOES Project is a joint effort between NASA and the National Oceanic and Atmospheric Administration (NOAA). Currently, the GOES system consists of GOES-12 operating as GOES-East in the eastern part of the constellation at 75° west longitude, and GOES-10 operating as GOES-West at 135° west longitude (GOES-11 is in storage at 105° west longitude). These spacecraft help meteorologists observe and predict local weather events, including thunderstorms, tornadoes, fog, flash floods, and other severe activities. In addition, GOES observations have proven helpful in monitoring dust storms, volcanic eruptions, and forest fires.

The GOES mission related benefits that directly enhance the quality of human life and protection of Earth's environment include:

- Supports the search and rescue satellite aided system (SARSAT)
- Contributes to the development of worldwide environmental warning services and enhancements of basic environmental services
- Improves the capability for forecasting and providing real-time warning of solar disturbances
- Provides data that may be used to extend knowledge and understanding of the atmosphere and its processes

GOES - NO/P is the next series of GOES satellites. This new series has several new top-level capabilities. These include:

- A digital Low Rate Information Transmission (LRIT) formatted Weather Facsimile (WEFAX) service
- Expanded measurements for the Space Environment Monitor (SEM) instruments
- A new dedicated channel for the Emergency Managers Weather Information Network (EMWIN) service
- A more stable pointing platform for supporting improved Imager and Sounder instrument measurements

The GOES - NO/P instrument compliment consists of an Imager, a Sounder, the SEM suite, and the Solar X-Ray Imager (SXI).

The Imager is a 5-channel instrument designed to sense radiant and solar-reflected energy from sampled areas of the Earth. The multi-element spectral channels simultaneously sweep east-west and west-east along a north-to-south path by means of a two-axis mirror scan system. The instrument can produce full-Earth disc images, sector images that contain the edges of the Earth, and various sizes of area scans completely enclosed within the Earth scene using a flexible scan system. Scan selection permits rapid continuous viewing of local areas for monitoring of mesoscale (regional) phenomena and accurate wind determination.

The Sounder is a 19-channel discrete-filter radiometer covering the spectral range from the visible channel wavelengths to 15 microns. It is designed to provide data from which atmospheric temperature and moisture profiles, surface and cloud-top temperatures, and ozone distribution can be deduced by mathematical analysis. It operates independently of and simultaneously with the Imager, using a similarly flexible scan system. The Sounder's multi-element detector array assemblies simultaneously sample four separate fields or atmospheric columns. A rotating filter wheel, which brings spectral filters into the optical path of the detector array, provides the infrared channel definition.

The SEM suite consists of four instrument groups: 1) an Energetic Particle Sensor (EPS) package, 2) two magnetometer sensors, 3) a solar X-Ray Sensor (XRS), and 4) an Extreme Ultraviolet (EUV) telescope.

Operating at all times, the SEM provides real-time data to the Space Environment Center (SEC) in Boulder, Colorado. The SEC, as the Nation's "space weather" center, receives, monitors, and interprets a wide variety of solar terrestrial data and issues reports, alerts, warnings, and forecasts for special events such as solar flares and geomagnetic storms.

The EPS accurately measures the number of particles over a broad energy range, including protons, electrons, and alpha particles, and are the basis for operational alerts and warnings of hazardous conditions. Energetic particles pose a risk to satellites and to astronauts, and they can disrupt navigation and communications systems used on the ground and in aircraft.

The magnetometer sensors can operate independently and simultaneously to measure the magnitude and direction of the Earth's geomagnetic field, detect variations in the magnetic field near the spacecraft, provide alerts of solar wind shocks or sudden impulses that impact the magnetosphere, and assess the level of geomagnetic activity. The second magnetometer sensor serves as a backup in case the first magnetometer sensor fails and provides for better calibration of the magnetometer data channel.

The XRS is an x-ray telescope that observes and measures solar x-ray emissions in two ranges, one from 0.05 to 0.3 nanometers (nm) and the second from 0.1 to 0.8 nm. In real-time, it measures the intensity and duration of solar flares in order to provide alerts and warnings of potential geophysical responses, such as changes in ionospheric conditions, that can disrupt radio communications and Global Positioning System (GPS) signals.

The 5-channel EUV telescope is new on the GOES-NO/P satellites. It measures solar extreme ultraviolet energy in five wavelength bands from 5 nm to 127 nm. The EUV

sensor provides a direct measure of the solar energy that heats the upper atmosphere and creates the ionosphere.

The SXI is essentially a small telescope that is used to monitor solar conditions and activity. Every minute the SXI captures a full disk image of the sun and its corona in the soft x-rays to the extreme UV range (0.6 nm to 6 nm), providing space weather forecasters with the necessary information in order to determine when to issue forecasts and alerts of conditions that may harm space and ground systems.

The GOES spacecraft will be launched on a Delta IV rocket from CCAFS. GOES-N is scheduled to be launched in December of 2004. The spacecraft weighs approximately 3206 kg (7053 lbs) and measures 8.2 m (26.8 ft) in length with solar arrays deployed, 2.3 m (7.5 ft) in height, and 2.3 m (7.5 ft) in width.

The components utilized in the GOES spacecraft and instruments are made of materials normally encountered in the space industry. GOES will use a radioactive source for on-orbit calibration of the High Energy Proton and Alpha Detector (HEPAD) in the EPS. Based on the A_2 Mission Multiple for this source, 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. GOES will not use any lasers. GOES will not carry any pathogenic organisms, nor will GOES return samples to Earth.

3.0 NASA Routine Payload Determination

The GOES missions have 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 missions meet the criteria for a routine payload. The radioactive sources are considered of small quantity and fall within the routine payload envelope. The missions do 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 GOES - NO/P missions qualify as a routine payload and fall within the scope of the reference routine payload EA. No additional NEPA action or documentation is required.

W. F. Townsend
for A. V. Diaz
Director

Enclosure

EVALUATION RECOMMENDATION PACKAGE

Record of Environmental Consideration
Routine Payload Checklist
NEPA Environmental Checklist

Enclosure

RECORD OF ENVIRONMENTAL CONSIDERATION

1. Project Name: Geostationary Operational Environmental Satellite (GOES-NO/P)

2. Description/location of proposed action: GOES satellites provide real-time weather data for use in short-term weather forecasting (warnings of severe weather) and space environment monitoring, as well as research and development. The GOES spacecraft will be launched on a Delta IV rocket from CCAFS. GOES-N is scheduled to be launched in December of 2004, followed by GOES-O in April 2007 and GOES-P in April 2008.

Date and/or Duration of project: GOES-N, Launch 4TH Q 04

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 Mahaffey — NEPA Coordinator, Code 250 — 6/3/04 Date

for David Mitchell, Code 415 — 6/14/04 Date

NASA Routine Payload Checklist (1 of 2)

PROJECT NAME: **Goes N Series (GOES N-P)** DATE OF LAUNCH: N – 12/04; O – 12/05, P – 4/07

PROJECT CONTACT: Darrell Zimbelman PHONE NUMBER: 301-286-5321 MAILSTOP: 415

PROJECT START DATE: January 1998 PROJECT LOCATION: GSFC, Building 6, W220

PROJECT DESCRIPTION: The GOES N Series satellite project will provide NOAA and the nation with the next generation weather satellites.

	YES	NO
A. SAMPLE RETURN:		
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)?		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: **GOES N Series (GOES N-P)** DATE OF LAUNCH: N – 12/04; O – 12/05, P – 4/07

PROJECT CONTACT: Darrell Zimbelman PHONE NUMBER: 301-286-5321 MAILSTOP: 415

PROJECT START DATE: January 1998 PROJECT LOCATION: GSFC, Building 6, W220

PROJECT DESCRIPTION: The GOES N Series satellite project will provide NOAA and the nation with the next generation weather satellites.

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)]
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
Communications	Various 10-100 W (RF) transmitters
Power	Solar cells; 150 A-Hr ($Ni-H_2$) battery; 300 A-Hr (LiSOC) battery; 150 A-Hr (NiCd) battery
Science instruments	10 kW radar 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 Propulsion system exhaust and inert gas venting

NEPA Environmental Checklist

1. Project/Program

GOES N Series (GOES N-P) – Code 416

2. Points of Contact

Project Manager: David F. Mitchell Code: 415 Telephone: x60415

S/C Manager: Andre Dress Code: 416 Telephone: x68705

Instrument Manager: Steve Benner Code: 416 Telephone: x68340

Other: Code: Telephone:

3. Schedule

Formulation Process (Phase A/B): N/A

Implementation Process (Phase C/D): January 1998 - Present

Launch Date: N – 12/04; O – 12/05; P – 4/07

Other Milestone Dates:

4. Current status

GOES N is currently in system level environmental testing. GOES O is preparing to start system level environmental testing. GOES P is in spacecraft level integration.

5. Project Description

a. Purpose/Need: The GOES N Series satellite project will provide NOAA and the nation with the next generation weather satellites.

b. Spacecraft/Instruments: The spacecraft is provided by Boeing and is based on their HSC-601 bus. The instrument complement includes an imaging radiometer, a sounder, a solar x-ray imager, and a space environment monitor suite that includes an energetic particle sensor package, two magnetometer sensors, a solar x-ray sensor, and an extreme ultraviolet sensor.

c. Launch Vehicle: Delta IV Family

d. Launch Site: CCAFS LC-37

e. Alternatives (to or for the mission): N/A

f. NASA's Involvement/Responsibility: NASA is responsible for procuring the satellites and the primary instruments, as well as performing on-orbit checkout prior to handover to NOAA. Under the contract, Boeing is responsible for the development and on-orbit delivery of each spacecraft.

g. Participants/Locations: Boeing Satellite Systems (El Segundo, CA), ITT Industries (Fort Wayne, IN), Lockheed Martin (Palo Alto, CA), GE/Panametrics

(Waltham, MA), SAIC (Columbia, MD), Boeing Expendable Launch Services (Huntington Beach, CA).

h. Mission Life: Each satellite is required to function for 10 years.

i. End of mission, Re-entry: At the end-of-life, each satellite will be raised approximately 200-250 km from the geosynchronous altitude as part of the NOAA de-orbit plan. In this orbit each spacecraft will never re-enter the Earth's atmosphere.

6. Is there anything controversial about the mission?

No.

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

No.

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

Routine Payload EA

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

An orbital debris assessment compliant with NSS 1740.14 and NMI 1700.8 has been generated. The assessment is currently being updated for the Delta IV following a launch vehicle change from the Delta III.

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

????

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.

X a. Fuels Monomethylhydrazine (631 kg) and Nitrogen Tetroxide (1022 kg)
X b. Radioactive Material Americium
X c. Explosives 54 Class C EEDs for mechanical deployments and propulsion system
X d. Chemicals Ammonia & propylene (heat pipes)
___ e. Hazardous Materials/Substances
___ f. Lasers (Class, Earth Pointing)
___ g. Disease Producing Pathogenic Microorganisms
___ h. Construction/Modification of a Facility
___ i. Discharges of any substances into air, water, or soil

_____j. Generation/Use/Storage/Disposal of Toxic or Hazardous Substances_____
_____k. Generation of Hazardous Wastes_____
_____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?

None other than those designated above.

Donald Frankhouse / Code 416
Project Manager, Code

6-14-04
Date

Explanations

Summary of GOES N Series (GOES N-P) Subsystems

Structural Materials	Aluminum, Magnesium, Carbon Resin Composites, Brass, Copper, Titanium, Germanium, Beryllium (< 50 kg)
Propulsion	Bipropellant system with 631 kg of monomethylhydrazine (fuel) and 1022 kg of nitrogen tetroxide (oxidizer)
Communications	• 8 W S-Band Transmitter (DSN) • 3 W L-Band Transmitter (CDA) • 3 W L-Band Transmitter (SAR) • 5 W L-Band Transmitter (SD) • 8 W L-Band Transmitter (MDL) • 35 W L-Band Transmitter (PDR) • 9 W L-Band Transmitter (WEFAX) • 3 W L-Band Transmitter (EMWIN) • 4 W L-Band Transmitter (DCPR) • 4 W UHF-Band Transmitter (DCPI)
Power	• 2.3 kW solar array with dual junction gallium arsenide cells • 123 Amp-hr Nickel Hydrogen battery
Science instruments	• 5-channel Imaging Radiometer • 19 channel Sounder • Solar X-Ray Imager • Space Environment Monitor suite (includes an energetic particle sensor package, two magnetometer sensors, a solar x-ray sensor, and an extreme ultraviolet sensor)
Other (include dimensions and weight of s/c)	Length with Deployed Solar Array – 8.2 m (26.8 ft.) Width – 2.3 m (7.5 ft.) Height – 2.3 m (7.5 ft.) Dry Mass – 1545 kg (3399 lbm) Wet Mass – 3206 kg (7053 lbm) 54 Class C EEDs used for mechanical deployments and propulsion system

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, MD 20771

February 23, 2004

Reply to Attn of: 250

TO: NASA Headquarters
Attn: QS/Nuclear Flight Safety Assurance Manager

FROM: 250/Radiation Protection Program Manager

SUBJECT: Request for Nuclear Launch Safety Approval

In accordance with NASA Procedural Requirement (NPR) 8715.3, Chapter 5, a request for approval is hereby submitted for the launch of radioactive material to be launched on a Goddard Space Flight Center sponsored project.

The radioactive sources reports are enclosed as required by NPR 8715.3, Chapter 5, paragraph 5.4.

If you have any questions, please contact me at (301) 286-5605.

Patrick Hancock

2 Enclosures

cc:
250/Ms. Montgomery
250.9/Mr. Simmons

661/Dr. Hartman

MINOR RADIOACTIVE SOURCES BEING LAUNCHED ON GSFC SPONSORED PROJECTS

Vehicle/ Spacecraft	Planned Launch Date (Mo/Yr)	Launch Site	Number of Sources	Isotope	Total Activity (Curies)	A_2 Limit for Isotope (Ci)	A_2 Multiple for Isotope	Remarks/Disposition
Delta IV/ GOES-N	Dec 2004	KSC	1	^{241}Am	4.05×10^{-9}	5.00×10^{-3}	8.10×10^{-7}	Used for internal calibration of HEPAD detector/Spacecraft will remain in permanent geosynchronous orbit upon exhaustion of fuel
						Mission Multiple →	8.10×10^{-7}	