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

April 1, 2009

Reply to Attn of: 454

MEMORANDUM FOR THE RECORD

National Environmental Policy Act (NEPA) Compliance for Tracking and Data Relay Satellite (TDRS) K and L

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.

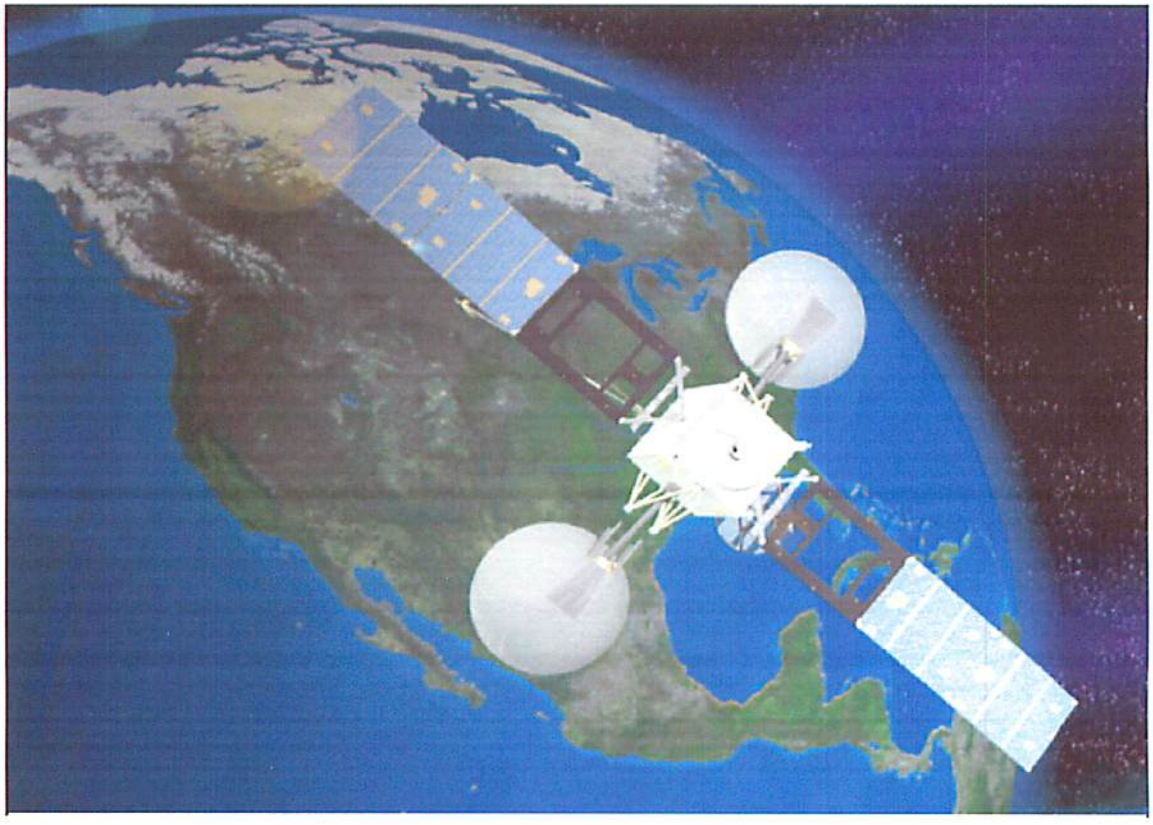
To determine the applicability of a routine payload classification for a mission launch from VAFB and CCAFS and coverage under the NASA routine payload EA, the mission is evaluated against the criteria defined in the EA using the Routine Payload Checklist (RPC).

2.0 Mission Description

TDRS K and L are part of the TDRS Replenishment Program. The objective of the Replenishment Program is to provide follow-on spacecraft required to maintain and expand the

Space Network by replacing the current constellation of geosynchronous TDRS satellites as they begin to exceed their designed lifetimes.

The current TDRS System (TDRSS) consists of nine (9) in-orbit telecommunications satellites, associated ground stations, and customer and data handling facilities. This system of satellites and ground stations comprises the TDRS portion of the Space Network that provides mission services for near Earth user satellites and orbiting vehicles. The system provides global communication and data relay services for the Space Shuttle, International Space Station, orbiting satellites, balloons and research aircraft.



Since the late 1950's NASA's method for providing data communications from orbiting satellites consisted of a network of powerful antennas at ground stations located around the world. The major disadvantage to this system was that the time available to communicate with the orbiting satellites as they passed overhead was very limited. As the number of satellites placed into orbit increased, researchers determined that a series of geo-stationary satellites could provide nearly continuous tracking and data transfer capabilities. The idea for a global system of communication satellites was developed through the 1970's and culminated with the launch of TDRS-1 in 1983. Following the loss of TDRS-2 in the Challenger accident in 1986, five (5) more TDRS satellites were launched over the next nine (9) years to provide the global coverage NASA provides today. TDRS-H (now known as TDRS-8), the first of the Replenishment Spacecraft, was launched in 2000, followed by the launch of TDRS-I in March 2002 and TDRS-J in December 2002.

Operating the TDRS satellites at fixed positions 22,300 miles high above the Earth in a geosynchronous orbit, the TDRSS constellation provides the broadest coverage to all users including research aircraft and launch vehicles. With its unique capability to view and track expendable launch vehicles, TDRSS has proven to be a viable, inexpensive alternative to traditional ground station or aircraft support for data acquisition during liftoff and other critical periods of communication. The TDRSS has been a test platform for a plethora of research trials such as radio-frequency propagation, very-long-base interferometry, digital radio broadcasting, telemedicine and aircraft satellite communications, which serve to advance civilian mobile and military communications. As the system ages, using residual assets has proved fruitful. For instance, the TDRS-1 satellite supports research efforts conducted at the South Pole by the National Science Foundation.

TDRS K and L will be launched on a Delta IV or an ATLAS-V launch vehicle from CCAFS. TDRS K will be launched in 2012 and TDRS-L will be launched in 2013. The TDRS spacecraft is based on the body-stabilized Boeing 601 satellite. The electrical power, attitude determination and control, and tracking, telemetry and control units are mounted on the bus structure, as are the solar array wings. The two solar array wings are covered with Ultra Triple Junction (UTJ) GaAs solar cells designed to provide a 15-year end of life power of approximately 3300 watts. Nickel hydrogen batteries, which supply power during eclipses, have autonomous battery charge maintenance. The propulsion and reaction control system is a bi-propellant system using monomethyl hydrazine fuel and nitrogen tetroxide oxidizer. The attitude control system is a momentum bias design, using a gimbaled momentum wheel for active three-axis torquing and momentum storage. A system of heat pipes, multi-layer insulation, radiators and thermostatic heater control, provide autonomous thermal control for all deployed operations.

The spacecraft is ~21 meters long (68 ft. 8 in.) with solar wings deployed and ~13.6 meters wide (44 ft. 9 in.) with antennas deployed. It weighs ~3,313 kg (7,304.5 lbs), which includes ~1,642 kg (3,620 lbs) of expendable fuel.

The functional and technical performance requirements for the replenishment satellites is virtually identical to those of the current TDRS HIJ (F8-10) satellites with the exception of providing multiple-access return services through ground based beamforming equipment and implementation of required changes to COMSEC algorithms.

The components utilized in the TDRS satellites are made of materials normally encountered in the space industry. TDRS will not use any radioactive materials or lasers. TDRS will not carry any pathogenic organisms, nor will TDRS return samples to Earth.

3.0 NASA Routine Payload Determination

The TDRS K & L 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 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 TDRS

missions qualify as a routine payload and fall within the scope of the reference routine payload EA.

At this point no additional NEPA action or documentation is required. However, NASA is in the process of updating the NASA Routine Payload EA. Once the Agency issues the final updated EA, NASA will review the potential environmental impacts of the proposed TDRS missions in the context of the new analysis and information contained in the updated EA. If NASA determines that there are substantial new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts, NASA will formally reopen the NEPA process for these missions.

Robert Strain 4/1/09
Director

Enclosure

EVALUATION RECOMMENDATION PACKAGE

Record of Environmental Consideration
Routine Payload Checklist
NEPA Environmental Checklist

Enclosure

RECORD OF ENVIRONMENTAL CONSIDERATION

1. Project Name: **Tracking and Data Relay Satellite (TDRS) K and L**

2. Description/location of proposed action:
Design, develop, build, ship, launch, achieve orbit, deploy, activate, calibrate and complete on orbit verification and acceptance of TDRS K and L spacecraft

Date and/or Duration of project: Launch (K – 4/2012 and L – 2/2013)

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.

Bob Montgomery — 3/10/2009
NEPA Program Manager, Code 250 — Date

Jeffrey J. Grantham — 3/12/2009
Project Manager, Code 454 — Date

GSFC Routine Payload Checklist

PROJECT NAME: TDRS K & L MISSIONS		DATE OF LAUNCHES: APRIL 2012 FOR K & FEBRUARY 2013 FOR L
PROJECT CONTACT: MARK FLANEGAN	PHONE NUMBER: 301-286-2416	MAILSTOP: 454
PROJECT START DATE: 12/28/2008	PROJECT LOCATION: GSFC MANAGED, BOEING EL SEGUNDO PRIME CONTRACTOR	
PROJECT DESCRIPTION: DESIGN, DEVELOP, BUILD, SHIP, LAUNCH, ACHIEVE ORBIT, DEPLOY, ACTVATE, CALIBRATE AND COMPLETE ON ORBIT VERIFICATION AND ACCEPTANCE OF TDRS K & L SPACECRAFT		

A. SAMPLE RETURN:	YES	NO
1. Would the candidate mission return a sample from an extraterrestrial body?	☐	☒
B. RADIOACTIVE SOURCES:	**YES**	**NO**
1. Would the candidate spacecraft carry radioactive materials?	☐	☒
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)?	☐	☐
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?	☐	☒
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?	☐	☒
Comments:		
D. FACILITIES:	**YES**	**NO**
1. Would the candidate mission require the construction of any new facilities or substantial modification of existing facilities?	☐	☒
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 (EPC's) in Table 2 below?	☐	☒
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)?	☐	☒
3. Would the candidate mission release material other than propulsion system exhaust or inert gases into the Earth's atmosphere or space?	☐	☒
4. Would launch of the candidate spacecraft suggest the potential for any substantial impact on public health and safety?	☐	☒
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).		
6. Would the candidate spacecraft contain pathogenic microorganisms (including bacteria, protozoa, and viruses) which can produce disease or toxins hazardous to human health?	☐	☒
Comments:		
F. OTHER ENVIRONMENTAL ISSUES:	**YES**	**NO**
1. Would the candidate spacecraft have the potential for substantial effects on the environment outside the United States?	☐	☒
2. Would launch and operation of the candidate spacecraft have the potential to create substantial public controversy related to environmental issues?	☐	☒
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

GODDARD SPACE FLIGHT CENTER
ENVIRONMENTAL CHECKLIST
FOR FLIGHT PROJECTS

1. PROJECT/PROGRAM

Tracking and Data Relay Satellite (TDRS) K and L

2. POINTS OF CONTACT

Name:	Code:	Phone No.:
Project Manager: Jeffrey Gramling	454	301-286-8520
Dep Proj Manager: Dave Littmann		301-286-2080

3. SCHEDULE

PDR/CDR:	Launch Date:
March of 2009/January 2010	K in April 2012 / L in February 2013

4. CURRENT STATUS

Contract Award in December 2007. Systems Definition Review (SDR) July 2008. System PDR scheduled for March 2009.

5. PROJECT DESCRIPTION

a. Purpose:
Design, develop, build, ship, launch, achieve orbit, deploy, activate, calibrate and complete on orbit verification and acceptance of TDRS K and L Spacecraft with options for two more (M,N)

b. Spacecraft:
Two Tracking and Data Relay Satellites (K,L)

c. Instruments:
Telecommunications Payload including receivers, processors, transmitters, antennas and associated equipment required to relay RF signals.

d. Launch Vehicle:
Delta IV or Atlas V

e. Launch Site:
Eastern Test Range

f. NASA's Involvement/Responsibility:
Program and Technical Management of contract to Boeing Satellite Systems.

g. Participants/Locations: NASA/GSFC, Greenbelt, MD; Boeing Satellite Systems, El Segundo, CA; NASA/Kennedy Space Center, FL

h. End of Mission, Re-entry:
At the end of the mission, the TDRS-K and L satellites will retire at a super synchronous orbit.

6. Is there anything controversial about the mission?

No.

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

None, similar in function and operation to TDRS HIJ and the current on-going TDRSS missions.

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

NEPA compliance for earlier versions of this spacecraft (TDRS J).
EA for launch vehicle TBD.

9. Is the mission (s/c and LV) compliant with NASA policy and guidelines for orbital debris (NPD 8710.3 and NSS 1740.14)? Explain non -compliances.

Compliant with NASA-STD-8719.14 and NPR 8715.6.

10. Has an Air Force Form 813 been completed? ☐ YES
(Please attach copy) ☒ NO

11. During any phase, does the mission/project 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.

A-yes	Fuels: Liquid Bi propellants (nitrogen tetroxide oxidizer and Monomethyl hydrazine fuel)
B-no	Ionizing Radiation Devices/Sources
C-yes	Explosives: pyrotechic actuators
D-yes	Hazardous Materials/Substances/Chemicals (ammonia in heat pipes)
E-no	Lasers (Class, Earth Pointing)
F-no	Disease Producing Pathogenic Microorganisms
G-no	Discharges of any Substances into Air, Water, or Soil
H-no	Hazardous Wastes
I-no	High Noise Levels
J-no	Sample Return to Earth
K-yes	Radio Frequency Communications (see communications below)
L-no	Construction/Modification/Demolition of a Facility
M-no	Land Disturbance, Tree Clearing, Removal of Vegetation
N-no	Impact on Threatened or Endangered Species
O-no	Impact/Destruction of Sensitive Wildlife Habitat
P-no	Impact on/near Areas of Cultural Significance
Q-no	Impact on Local Social or Economic Conditions (Traffic, Employment, etc)
R-no	Impact on Minority or Low Income Populations
S-no	New or Foreign Launch Vehicle
T-no	Other Issues of Potential Environmental Impact
U-no	Require any Environmental Permit

Additional Information

12. What Safety hazards are associated with the mission?

Liquid Bi propellants (nitrogen tetroxide oxidizer and Monomethyl hydrazine fuel), Pyrotechnic Actuators, 4200 psia COPV.

13. Summary of subsystem components

Structural Materials	Aluminum honeycomb, graphite composite, titanium, beryllium, steel
Propulsion	Four circular tanks; two composite overwrap pressure vessels (COPV); propellant tanks are titanium 6Al-4V with 1035kg NTO in two tanks, 638kg of MMH in two propellant tanks
Communications	S, Ku and Ka band antennas with Solid State Power Amplifiers and TWTA (70W)
Power	Solar Cells; 110 AHr NiH2 battery
Science Instruments	None, payload is communications equipment.
Hazardous Components (radioactive materials, lasers, chemicals, etc.)	Liquid Bi propellants (nitrogen tetroxide oxidizer and Monomethyl hydrazine fuel), Pyrotechnic Actuators, 4200 psia COPV
Other (include dimensions and weight of s/c)	3313 kg total mass, 1642 kg fuel 824 inch x 537 inch x 300 inch deployed

PROJECT MANAGER NAME Jeffrey Gramling	DATE
PROJECT MANAGER SIGNATURE	3/13/09