National Aeronautics and Space Administration
Mission Support Directorate

**NASA Management Office**
180-801
4800 Oak Grove Drive
Pasadena, CA 91109-8099

Reply to Attn of: LP040

DATE July 27, 2015

SUBJECT: Revised Memorandum for the Record for the Interior Exploration using Seismic Investigations, Geodesy and Heat Transport (InSight) and Mars Cube One (MarCO) Missions

MEMORANDUM FOR THE RECORD

The Memorandum for the Record, based on the Environmental Evaluation and Recommendation for NASA Routine Payload Categorization for the InSight mission, was signed by John M. Grunsfeld, Associate Administrator for the NASA Science Mission Directorate, on June 25, 2013. Since that time, two six-Unit Mars Cube One (MarCO) U-Class satellites have been co-manifested on the InSight Atlas V Centaur second stage. The InSight and MarCO missions have been reviewed together in accordance with the Routine Payload criteria established in the "Environmental Assessment for Launch of NASA Routine Payloads on Expendable Launch Vehicles," dated November 2011 and Finding of No Significant Impact (FONSI) dated November 22, 2011. There is no indication that the addition of these two U-Class satellites and the Tyvak Nanosatellite Launch Adapter System (NLAS) deployment mechanism to the Atlas V Centaur second stage would have any greater environmental impact than those normally encountered during launch at Vandenberg Air Force Base (VAFB). This proposed action has been reviewed against the National Environmental Policy Act, the implementing regulations of the Council on Environmental Quality, and the implementing regulations of NASA. Following my review, I have determined that the proposed action continues to be adequately covered in an existing Environmental Assessment (EA) entitled *Environmental Assessment for Launch of NASA Routine Payloads on Expendable Launch Vehicles* dated November 2011 and Finding of No Significant Impact (FONSI) dated November 22, 2011.

My signature on this document constitutes a written record of this decision.

Steve Slaten
Environmental and Facilities Manager
NASA Management Office

Enclosures:
Revised Environmental Evaluation and Recommendation for NASA Routine Payload Categorization of the InSight Mission, dated July 27, 2015
Evaluation Checklist for Applicability of the NASA Routine Payload Environmental Assessment
Environmental Affairs Program Office (EAPO) Checklists for On-Site Environmental Evaluation of Proposed Action for InSight and MarCO

cc: Office of General Counsel/Mr. Hayes
Environmental Management Division/Ms. Norwood
Jet Propulsion Laboratory/Mr. J. M. Phillips
Jet Propulsion Laboratory /Mr. T. L. Hoffman
Jet Propulsion Laboratory/J. A. Krajewski

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July 27, 2015

**Memorandum for the File: Supplement to the Environmental Evaluation and Recommendation for NASA Routine Payload Categorization of the Interior exploration using Seismic Investigations, Geodesy and Heat Transport (InSight) and Mars Cube One (MarCO) Missions**

REF: Memorandum for the Record for the Interior exploration using Seismic Investigations, Geodesy and Heat Transport (InSight) Mission, dated February 15, 2012
Environmental Evaluation and Recommendation for NASA Routine Payload Categorization of the InSight Project, dated March 21, 2013
InSight/Mars Cube One (MarCO) Evaluation Checklist for Applicability of the NASA Routine Payload Environmental Assessment
EAPO Checklist for On-Site Environmental Evaluation of Proposed Action for InSight
EAPO Checklist for On-Site Environmental Evaluation of Proposed Action for MarCO

In 2013, the InSight mission was reviewed in accordance with the Routine Payload criteria established by the "*Final Environmental Assessment for Launch of NASA Routine Payloads on Expendable Launch Vehicles,*" (2011 NRP EA), dated November 2011. The finding by NASA Headquarters based upon that review was the InSight mission was within the scope of the 2011 NRP EA and its Finding of No Significant Impact (FONSI) dated November 22, 2011. Information supporting that finding can be found in the first two referenced documents above.

Since the Memorandum for the Record and Environmental Evaluation and Recommendation for NASA Routine Payload Categorization were signed, two six-Unit Mars Cube One (MarCO) U-Class satellites have been co-manifested on the InSight Atlas V Centaur second stage. The InSight and MarCO missions have been reviewed together in accordance with the Routine Payload criteria established in the "Environmental Assessment for Launch of NASA Routine Payloads on Expendable Launch Vehicles," dated November 2011 and Finding of No Significant Impact (FONSI) dated November 22, 2011. There is no indication that the addition of these two MarCO U-Class satellites and the Tyvak Nanosatellite Launch Adapter System (NLAS) deployment mechanism to the Atlas V Centaur second stage would have any greater environmental impact than those normally encountered during launch at Vandenberg Air Force Base (VAFB).

Based on the Routine Payload Checklists for InSight and the two MarCO U-Class satellites, the potential environmental impact is well within the scope and level of missions analyzed in the 2011 NRP EA. Because the combination of InSight and the two MarCO satellites meets the criteria given in the 2011 NRP EA Routine Payload Checklist, it is our recommendation that InSight should still be considered to be encompassed by the existing NEPA documentation and that the NASA environmental review requirements for the InSight launch have been fulfilled.

Approval:

V.S. Ryan, Supervisor
Launch Approval Engineering
Group

7-27-15
Date

Concurrence:

J. Mark Phillips, Manager
Launch Approval Engineering
Office (Acting)

7/27/2015
Date

**Jet Propulsion Laboratory**
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Concurrence:

7-29-15

Tom L. Hoffman, Manager
InSight Project

Date

Concurrence:

7-28-15

Joel A. Krajewski, Manager
MarCO Project

Date

**Description of Proposed Missions:**

**Interior exploration using Seismic Investigations, Geodesy and Heat Transport (InSight):**

InSight is a proposed NASA Discovery Program mission that would place a single geophysical lander on Mars to study its deep interior. By using sophisticated geophysical instruments, it would address fundamental questions about the formation of Earth-like planets by detecting the fingerprints of those processes buried deep within the interior of Mars.

InSight would be launched from Vandenberg Air Force Base (VAFB) California on an Atlas V launch vehicle no earlier than March 4, 2016.

The proposed InSight science payload would consist of two instruments: the Seismic Experiment for Interior Structure (SEIS) provided by the French Space Agency (CNES) and the Heat Flow and Physical Properties Package ($HP^3$) provided by the German Space Agency (DLR). In addition, the Rotation and Interior Structure Experiment (RISE), led by JPL, would use the spacecraft communication system to provide precise measurements of planetary rotation.

InSight's primary science objective would be to uncover how a rocky body forms and evolves to become a planet. Generally, a rocky body begins its formation through a process called accretion. As the body increases in size, its interior heats up and melts. As it subsequently cools and recrystallizes it evolves into what we know today as a terrestrial planet, containing a core, mantle and crust. While all of the terrestrial planets share similar structures and their bulk compositions are roughly the same as the meteoritic material from which they were formed, they are by no means uniform. Each of the terrestrial planets reached their current formation and structure through a process known as differentiation, which is poorly understood. InSight's goal would be to solve the mystery of differentiation in planetary formation - and to bridge the gap of understanding that lies between accretion, and the final formation of a terrestrial planet's core, mantle, and crust.

The mission's secondary objective would be to conduct an in-depth study of tectonic activity and meteorite impacts on Mars, both of which could provide valuable knowledge about such processes on Earth.

To achieve each of these objectives, InSight would conduct six investigations at the Martian surface. The proposed science goals and objectives of InSight would be to:

1. Understand the formation and evolution of terrestrial planets through investigation of the interior structure and processes of Mars by:
   - Determining the size, composition and physical state (liquid/solid) of the Martian core;
   - Determining the thickness and structure of the Martian crust;
   - Determining the composition and structure of the Martian mantle; and
   - Determining the thermal state of the Mars' interior.
2. Determine the present level of tectonic activity and meteorite impact rate on Mars by:
   - Measuring the magnitude, rate and geographical distribution of Mars' internal seismic activity, and
   - Measuring the rate of meteorite impacts on the surface of Mars.

The payload instruments would consist of:

- The Seismic Experiment for Interior Structure (SEIS), provided by the French Space Agency (CNES), with the participation of the Institut de Physique du Globe de Paris (IPGP), the Swiss Federal Institute of Technology (ETH), the Max-Planck-Institute for Solar System Research (MPS), Imperial College and the Jet Propulsion Laboratory (JPL); This instrument would capture Mars' pulse, or its internal activity. SEIS would take precise measurements of quakes and other internal activity on Mars to better understand the planet's history and structure.
- The Heat Flow and Physical Properties Package ($HP^3$), provided by the German Space Agency (DLR) would be a heat flow probe on the surface of Mars and would be a key indicator of planetary evolution by providing the temperature at Mars. $HP^3$ would hammer five meters (16 feet) into the Martian subsurface, deeper than all previous arms, scoops, drills and probes, to learn how much heat is coming from Mars' interior and reveal the planet's thermal history.
- The Rotation and Interior Structure Experiment (RISE), led by JPL, would use the spacecraft communication system to provide precise measurements of planetary rotation. RISE would track the way Mars wobbles when it is pulled by the Sun by precisely measuring the Doppler shift and ranging of radio communications sent between the InSight lander and Earth. By tracking wobble, scientists could determine the distribution of the Red Planet's internal structures and better understand how the planet is built.
- InSight would incorporate a camera, similar to the "Navcam" engineering cameras onboard the Mars Science Laboratory (MSL), mounted on the arm of the lander that would serve to capture color images of the instruments on the lander's deck and a 3-D view of the ground where the seismometer and heat flow probe would be placed. It would then be used to help engineers and scientists guide the deployment of the instruments to the ground. With a 45-degree field of view, the camera would also provide a panoramic view of the terrain surrounding the landing site.
- A second similar camera, with a wide-angle 120-degree field of view lens like the "Hazcam" cameras on MER, would be mounted under the edge of the lander's deck and would provide a complementary view of the instrument deployment area.

**Mars Cube One (MarCO):**

MarCO, consisting of two briefcase-size U-Class satellites, would be an experimental communications relay service to quickly inform Earth about InSight's landing. MarCO would launch on the Centaur second stage of the InSight mission's Atlas V launch vehicle, and deploy from a Tyvak Nanosatellite Launch Adapter System (NLAS) mechanism well after InSight separates on its direct trajectory to Mars. The two 6-Unit (each unit is 10-centimeter (cm) (4-inch (in)) cube) U-Class satellites would have independent powered flight via a cold gas propulsion system to Mars. Each MarCO unit would have a stowed size of about 36.6 by 24.3 cm by 11.8 cm (14.4 by 9.5 in by 4.6 in). The two U-Class satellites would fly by Mars at an altitude of 3500 kilometer (km) (2170 miles), and would always remain in view of Earth to enable them to playback data after InSight Entry, Descent and Landing (EDL). These U-CLASS satellites would utilize heritage based on the Interplanetary NanoSpacecraft Pathfinder in a Relevant Environment (INSPIRE) design and acquired experience. The 6-Unit satellite volume would enable adding more power, larger antennas, reaction wheels, and more propulsion to the INSPIRE design. MarCO would not be part of the InSight mission, nor would it be needed for InSight's mission success.

The Tyvak NLAS deployer is a rectangular box, made out of aluminum, with a door and a spring mechanism. Once the release mechanism of the Tyvak NLAS door is actuated, a set of torsion springs at the door hinge swing the door open, and the satellites are deployed by the main spring, sliding on the Tyvak NLAS smooth flat rails.

**Statement of Purpose and Need:**

Congress enacted the National Aeronautics and Space Act of 1958 “to provide for research into problems of flight within and outside Earth’s atmosphere” and to ensure that the United States conducts activities in space devoted to peaceful purposes for the benefit of humanity. In 2010, the Administration updated the U.S. National Space Policy (National Space Policy), which recognizes the essential nature of space for our national and global well-being, including our roles in space science, exploration, and discovery. In the same year, Congress passed, and the President signed, the NASA Authorization Act providing the Agency important guidance in program content and conduct.

In response to the 2010 NASA Authorization Act, NASA published a new Strategic Plan in 2011. The second of six strategic goals and outcomes within this plan is to “expand scientific understanding of the Earth and the universe in which we live.” Under this strategic goal NASA seeks to ascertain the content, origin, and evolution of the solar system and the potential for life elsewhere. NASA also seeks to discover how the Universe works, explore how it began and evolved, and search for Earth-like planets. Objectives under this strategic goal and outcome include activities and missions which:

- Inventory solar system objects and identify the processes active in and among them;
- Improve the understanding of how the Sun’s family of planets, satellites, and minor bodies originated and evolved;
- Improve understanding of the processes that determine the history and future of habitability of environments on Mars and other solar system bodies; and
- Improve understanding of the origin and evolution of Earth’s life and biosphere to determine if there is or ever has been life elsewhere in the universe.

The 2010 Science Mission Directorate (SMD) Science Plan states that NASA’s goal in Planetary Science is to “ascertain the content, origin, and evolution of the solar system, and the potential for life elsewhere.” NASA missions pursue this goal by seeking answers to fundamental science questions such as:

- What is the inventory of solar system objects and what processes are active in and among them?
- How did the Sun’s family of planets, satellites, and minor bodies originate and evolve?
- What are the characteristics of the solar system that lead to habitable environments?
- How and where could life begin and evolve in the solar system?
- What are characteristics of small bodies and planetary environments that pose hazards and/or provide resources?

The Discovery Program of innovative missions is one of the major elements of the SMD Planetary Division’s strategy to find answers to these questions. Discovery investigations to the inner planets and small bodies include fly-by, orbiter, lander, rover, and sample return missions, each offering a different approach to expand our body of knowledge.

InSight would provide scientific data to aid in answering all of the fundamental science questions for Mars and would also align with NASA’s strategic goal mentioned previously: “Expand scientific understanding of the Earth and the universe in which we live.” By using sophisticated geophysical instruments, InSight would delve deep beneath the surface of Mars, detecting the fingerprints of the processes of terrestrial planet formation, as well as measuring the planet's "vital signs": Its "pulse" (seismology), "temperature" (heat flow probe), and "reflexes" (precision tracking).

The InSight mission would follow the legacy of NASA's Mars Phoenix mission by sending a lander to Mars, which would delve deeper into the surface than any other spacecraft - to investigate the planet's

structure and composition as well as its tectonic activity as it relates to all terrestrial planets, including Earth. Because Mars has been less geologically active than the Earth, it actually retains a more complete record of its history in its own basic planetary building blocks: its core, mantle and crust. By studying the size, thickness, density and overall structure of the Red Planet's core, mantle and crust, as well as the rate at which heat escapes from the planet's interior, the InSight mission would provide glimpses into the evolutionary processes of all of the rocky planets in the inner solar system, including Earth, by investigating the interior structure and processes of Mars. InSight would also investigate the dynamics of Martian tectonic activity and meteorite impacts, which could offer clues about such phenomena on Earth.

InSight has no direct-to-Earth link during critical landing events, and would have to wait for Mars Reconnaissance Orbiter (MRO) to relay the EDL data hours later. MarCO would be a technology demonstration of a communications relay system; MarCO's key payload would be its relay radio. The ultra-high frequency (UHF) on MarCO would be receive-only. The X-band would be for receiving and transmitting communications with Earth, capable of immediately relaying information being received via UHF. MarCO would provide real-time data relay for InSight's EDL while the two spacecraft perform a slow flyby of Mars.

**JPL Facility Requirements**

The InSight and MarCO Projects have independently coordinated with the JPL Environmental Affairs Program Office (EAPO) to ensure InSight and MarCO activities at JPL are within the limits and requirements described by JPL facility permits and environmental documentation. Changes to InSight or MarCO facility needs or requirements would be coordinated with the EAPO to ensure compliance with all pertinent permits and environmental documentation. EAPO has provided an On-site Environmental Evaluation Checklist for each, which are attached to this document.

## Evaluation Checklist for Applicability of the NASA Routine Payload Environmental Assessment

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT NAME:** | Interior Exploration using Seismic Investigations, Geodesy, and Heat Transport (Insight) and Mars Cube One (MarCO) | | | **LAUNCH DATE :** | NET March 4, 2016 |
| **PROJECT CONTACT:** | Tom Hoffman | **PHONE NUMBER:** | 818-354-6521 | **MAILSTOP:** | 321-320 |
| **PROJECT START:** | May 2, 2011 | **PROJECT NAME (or TASK PLAN/ORDER NUMBER) and LOCATION:** | | 40-16848 LRG, JPL | |
| **PROJECT DESCRIPTION:** | InSight would be a Mars landed mission to investigate the internal properties of Mars over the course of a ~1 Martian year. MarCO would be dual U-Class Satellites co-manifested with InSight to fly independently to Mars and provide direct-to-Earth telecommunication support for Insight's Entry, Descent and Landing. | | | | |

Note: "YES" responses require explanation in the comment field at the end of each section, and may require the conduct of additional studies or preparation of additional NEPA compliance documentation.

| **A.** | **Sample Return:** | **YES** | **NO** |
|---|---|---|---|
| 1. | Would the candidate mission return a sample from an extraterrestrial body? | | **X** |
| Comment | | | |
| **B.** | **Radioactive Materials:** | **YES** | **NO** |
| 1. | Would the candidate spacecraft carry radioactive materials in quantities that produce an A2 mission multiple value of 10 or more? | | **X** |
| Comment | | | |
| **C.** | **Launch and Launch Vehicles:** | **YES** | **NO** |
| 1. | Would the candidate spacecraft be launched on a vehicle and launch site combination other than those listed in Table 1 below? | | **X** |
| 2. | Would launch of the proposed mission exceed the approved or permitted annual launch rate for the particular launch vehicle or launch site? | | **X** |
| Comment | | | |
| **D.** | **Facilities:** | **YES** | **NO** |
| 1. | Would the candidate mission require the construction of any new facilities or substantial modification of existing facilities? (If YES, provide a brief description below of the construction or modification required, including whether ground disturbance and/or excavation would occur) | | **X** |
| Comment | | | |
| **E.** | **Health and Safety:** | **YES** | **NO** |
| 1. | Would the candidate spacecraft utilize batteries, ordnance, hazardous propellant, radiofrequency transmitter power, or other subsystem components in quantities or levels exceeding the Envelope Payload Characteristics (EPCs) in Table 2 below? | | **X** |
| 2. | Would the expected risk of human casualty from spacecraft planned orbital reentry exceed the criteria specified by NASA Standard 8719.14? | | **X** |
| 3. | 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 Characteristics (EPCs)? | | **X** |
| 4. | Would the candidate mission, under nominal conditions, release material other than propulsion system exhaust or inert gases into the Earth's atmosphere or space? | | **X** |
| 5. | Are there changes in the preparation, launch or operation of the candidate spacecraft from the standard practices described in Chapter 3 of the *Final Environmental Assessment for Launch of NASA Routine Payloads on Expendable Launch Vehicles* dated November 2011? | | **X** |
| 6. | Would the candidate spacecraft utilize an Earth-pointing laser system that does not meet the requirements for safe operation (ANSI Z136.1-2007 and ANSI Z136.6-2005)? | | **X** |
| 7. | Would the candidate spacecraft contain, by design (e.g., a scientific payload) pathogenic microorganisms (including bacteria, protozoa, and viruses) which can produce disease or toxins hazardous to human health or the environment beyond Biosafety Level 1 (BSL 1)[1]? | | **X** |
| Comment | | | |

[1] The use of biological agents on payloads is limited to materials with a safety rating of "Biosafety Level 1." This classification includes defined and characterized strains of viable microorganisms not known to consistently cause disease in healthy human adults. Personnel working with Biosafety Level 1 agents follow standard microbiological practices including the use of mechanical pipetting devices, no eating drinking, or smoking in the laboratory, and required hand-washing after working with agents or leaving a lab where agents are stored. Personal protective equipment such as gloves and eye protection is also recommended when working with biological agents.

## Evaluation Checklist for Applicability of the NASA Routine Payload Environmental Assessment

| | | | | | |
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| **PROJECT DESCRIPTION:** | InSight would be a Mars landed mission to investigate the internal properties of Mars over the course of a ~1 Martian year. MarCO would be dual U-Class Satellites co-manifested with InSight to fly independently to Mars and provide direct-to-Earth telecommunication support for Insight's Entry, Descent and Landing | | | | |

Note: "YES" responses require explanation in the comment field at the end of each section, and may require the conduct of additional studies or preparation of additional NEPA compliance documentation.

| 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 |
| 3. | Would any aspect of the candidate spacecraft that is not addressed by the Envelope Payload Characteristics (EPCs) have the potential for substantial effects on the environment (i.e., previously unused materials, configurations or material not included in the checklist)? | | X |
| Comment | | | |

### Table 1. Launch Vehicles and Launch Sites

| Launch Vehicle and Launch Vehicle Family | Space Launch Complexes and Pads | | | | |
|---|---|---|---|---|---|
| | Eastern Range (CCAFS) | Western Range (VAFB) | USAKA/RTS | WFF | KLC |
| Athena I, IIc, III[a] | LC-46 | CA Spaceport (SLC-8) | N/A | Pad 0 | LP-1 |
| Atlas V Family | LC-41 | SLC-3 | N/A | N/A | N/A |
| Delta II Family | LC-17 | SLC-2 | N/A | N/A | N/A |
| Delta IV Family | LC-37 | SLC-6 | N/A | N/A | N/A |
| Falcon 1/1e | LC-36 | SLC-4W | Omelek Island | Pad 0 | LP-3[a] |
| Falcon 9 | LC-40 | SLC-4E | Omelek | Pad 0 | LP-3[a] |
| Minotaur I | LC-20 and/or LC-46 | SLC-8 | N/A | Pad 0 | LP-1 |
| Minotaur II-III | LC-20 and/or LC-46 | SLC-8 | N/A | Pad 0 | LP-1 |
| Minotaur IV[b] | LC-20 and/or LC-46 | SLC-8 | N/A | Pad 0 | LP-1 |
| Minotaur V | LC-20 and/or LC-46 | SLC-8 | N/A | Pad 0 | LP-1 |
| Pegasus XL | CCAFS skidstrip KSC SLF | VAFB Airfield | Kwajalein Island | WFF Airfield | N/A |
| Taurus | LC-46 and/or LC-20 | SLC-576E | N/A | Pad 0 | LP-1 |
| Taurus II/Antares[c] | NA | NA | N/A | Pad 0 | LP-3[a] |
| Any other launch vehicle/launch site combination for which NASA has completed or cooperated on the NEPA Compliance | | | | | |

[a] Athena III and LP-3 are currently under design
[b] While not explicitly listed in this table, the Minotaur IV includes all configurations of this launch vehicle, including the Minotaur IV+, which is a Minotaur IV with a Star 48V 4th stage.
[c] The Taurus II LV was renamed Antares after publication of the Final Environmental Assessment for Launch of NASA Routine Payloads on Expendable Launch Vehicles in November 2011.

**Key:** CA=California; CCAFS=Cape Canaveral Air Force Station; KSC=Kennedy Space Center; LC=Launch Complex; LP=Launch Pad; MARS=Mid-Atlantic Regional Spaceport; SLC=Space Launch Complex; SLF=Shuttle Landing Facility; USAKA/RTS=United States Army Kwajalein Atoll/Reagan Test Site; VAFB=Vandenberg Air Force Base; WFF=Wallops Flight Facility, KLC = Kodiak Launch Complex, Alaska.

**Evaluation Checklist for Applicability of the NASA Routine Payload Environmental Assessment**

| | | | | | |
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Note: "YES" responses require explanation in the comment field at the end of each section, and may require the conduct of additional studies or preparation of additional NEPA compliance documentation.

**Table 2. Summary of Envelope Payload Characteristics (EPCs) by Spacecraft Subsystems**

| | |
|---|---|
| **Structure** | • Unlimited: aluminum, beryllium, carbon resin composites, magnesium, titanium, and other materials unless specified as limited. |
| **Propulsion**[a] | • Liquid propellant(s); 3,200 kg (7,055 lb) combined hydrazine, monomethylhydrazine and/or nitrogen tetroxide.<br>• Solid Rocket Motor (SRM) propellant; 3,000 kg (6,614 lb) Ammonium Perchlorate (AP)- based solid propellant (examples of SRM propellant that might be on a spacecraft are a Star-48 kick stage, descent engines, an extra-terrestrial ascent vehicle, etc.) |
| **Communications** | • Various 10-100 Watt (RF) transmitters |
| **Power** | • Unlimited Solar cells; 5 kilowatt-Hour (kW-hr) Nickel-Hydrogen ($NiH_2$) or Lithium ion<br>• (Li-ion) battery, 300 Ampere-hour (A-hr) Lithium-Thionyl Chloride (LiSOCl), or 150 A-hr Hydrogen, Nickel-Cadmium (NiCd), or Nickel-hydrogen (Ni-$H_2$) battery. |
| **Science Instruments** | • 10 kilowatt radar<br>• American National Standards Institute safe use of lasers (see Section 4.1.2.1, Final Environmental Assessment for Launch of NASA Routine Payloads on Expendable Launch Vehicles, November 2011) |
| **Other** | • U. S. Department of Transportation (DoT) Class 1.4 Electro-Explosive Devices (EEDs) for mechanical systems deployment<br>• Radioactive materials in quantities that produce an A2 mission multiple value of less than 10<br>• Propulsion system exhaust and inert gas venting<br>• Sample returns are considered outside of the scope of this environmental assessment |

[a] Propellant limits are subject to range safety requirements.

**Key:** kg=kilograms; lb=pounds.

## EAPO Checklist for On-Site Environmental Evaluation of Proposed Action

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT NAME:** | Interior Exploration using Seismic Investigations, Geodesy, and Heat Transport (InSight) | | | **LAUNCH DATE :** | NET March 4, 2016 |
| **PROJECT CONTACT:** | Tom Hoffman | **PHONE NUMBER:** | 818-354-6521 | **MAILSTOP:** | 321-320 |
| **PROJECT START:** | May 2, 2011 | **PROJECT NAME (or TASK PLAN/ORDER NUMBER) and LOCATION:** | | 40-16848 LRG, JPL | |
| **PROJECT DESCRIPTION:** | This would be a Mars landed mission. It would be investigating the internal properties of Mars over the course of a ~1 Martian year. | | | | |

Note: "YES" responses require explanation in the comment field at the end of each section, and may require the conduct of additional studies or preparation of additional NEPA compliance documentation.

| **A.** | **Geologic:** | **YES** | **MAYBE** | **NO** |
|---|---|---|---|---|
| 1. | Greater than a 10% change in topography or ground surface relief features? | | | x |
| 2. | Any increase in wind or water erosion of soils, either on or off site? | | | x |
| 3. | Changes in deposition, siltation, or erosion that may modify wetlands? | | | x |
| Assessment: | | | | |
| **B.** | **Air:** | **YES** | **MAYBE** | **NO** |
| 1. | Classified as either a New Emission Source or a major modification to an existing source (SCAQMD Regulation XIII)? | | | x |
| 2. | Creation of objectionable odors? | | | x |
| 3. | Alteration of air movement, moisture, temperature, or any changes in climate, either locally or regionally? | | | x |
| Assessment: | | | | |
| **C.** | **Water:** | **YES** | **MAYBE** | **NO** |
| 1. | Disturbance of groundwater? | | | x |
| 2. | Alteration of the direction or rate of ground waters? | | | x |
| 3. | Change in the quantity of ground waters, either through direct additions or withdrawals, or through interception of an aquifer by cuts or excavations? | | | x |
| 4. | Greater than 10% changes in absorption rates, drainage patterns, or the rate and amount of surface runoff? | | | x |
| 5. | Alter the course or flow of flood waters? | | | x |
| 6. | Activities resulting in changes of greater than 10% of Laboratory total potable water use? | | | x |
| 7. | Any construction or other activity in a floodplain or wetland? | | | x |
| 8. | Generate industrial waste water or storm water discharge? | | | x |
| Assessment: | | | | |
| **D.** | **Cultural Resources:** | **YES** | **MAYBE** | **NO** |
| 1. | Project located in a historic district, in or near a historic property, or affects an existing national historic landmark? | | | x |
| 2. | Will Project alter all or part of an eligible structure? | | | x |
| 3. | Project located in an area of suspected archeological resources? | | | x |
| Assessment: | | | | |
| **E.** | **Biological Resources:** | **YES** | **MAYBE** | **NO** |
| 1. | Construction/grading/filling within or adjacent to designated wetlands? | | | x |
| 2. | Reduction of the numbers of any rare or endangered species? | | | x |
| 3. | Construction/grading/filling within open space or grasslands areas? | | | x |
| 4. | Introduction of new species or plants into an area, or impact the normal replenishment of existing species? | | | x |
| 5. | Proposed construction activities in designated critical habitat? | | | x |
| 6. | Propose new landscaping or modify existing landscaping? | | | x |
| Assessment: | | | | |

## EAPO Checklist for On-Site Environmental Evaluation of Proposed Action

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT NAME:** | Interior Exploration using Seismic Investigations, Geodesy, and Heat Transport (InSight) | | | **LAUNCH DATE :** | NET March 4, 2016 |
| **PROJECT CONTACT:** | Tom Hoffman | **PHONE NUMBER:** | 818-354-6521 | **MAILSTOP:** | 321-320 |
| **PROJECT START:** | May 2, 2011 | **PROJECT NAME (or TASK PLAN/ORDER NUMBER) and LOCATION:** | | 40-16848 LRG, JPL | |
| **PROJECT DESCRIPTION:** | This would be a Mars landed mission. It would be investigating the internal properties of Mars over the course of a ~1 Martian year. | | | | |

Note: "YES" responses require explanation in the comment field at the end of each section, and may require the conduct of additional studies or preparation of additional NEPA compliance documentation.

| F. | **Noise:** | **YES** | **MAYBE** | **NO** |
|---|---|---|---|---|
| 1. | Noise increase greater than 10% from an existing operation? | | | x |
| 2. | Exposure of people to severe noise levels (> 80 dBA)? | | | x |
| 3. | Increase existing Community Noise Equivalent Level (CNEL) noise contours? | | | x |
| Assessment: | | | | |

| G. | **Land Use:** | **YES** | **MAYBE** | **NO** |
|---|---|---|---|---|
| 1. | Substantial alteration of present or planned land use? | | | x |
| 2. | Increase in rate of use of any natural resource? | | | x |
| 3. | Activities resulting in changes of greater than 10% of facility energy consumption? | | | x |
| 4. | Activities resulting in a change in total employment levels greater than 10% ? | | | x |
| Assessment: | | | | |

| H. | **Health and Safety:** | **YES** | **MAYBE** | **NO** |
|---|---|---|---|---|
| 1. | Generation of ionizing or non-ionizing radiation? | x | | |
| 3. | Use of pesticides, including insecticides, herbicides, fungicides or rodenticides? | | | x |
| 4. | Confined space entry? | | | x |
| 5. | Risk of exposure to asbestos or lead-containing materials? | | | x |
| 6. | Result in exposure or disturbance of contaminated soil or ground water? | | | x |
| 7. | Use of Class 1 ozone depleting substances (CFCs, TCA, halons)? | | | x |
| 8. | Acquisition, use, or storage of any toxic or hazardous substance? | x | | |
| 9. | Generation of medical (biohazard), hazardous, toxic, or radiological wastes? | | | x |
| 10. | Use, disturbance, or disposal of PCBs? | | | x |
| 11. | Use of toxic gas? | | | x |
| Assessment: | The proposed task would include the use of hazardous substances and lasers. The EAPO has verified that pre-Operational Safety Reviews (OSR) are on file with the JPL Occupational Safety Office (14-3890-423, 14-3830-352, and 13-3820-127). The pre-OSRs include a safety assessment and personal and facility safety requirements. Thus, the proposed task conducted according to the requirements of the pre-OSR would not pose a substantial threat to worker health and safety. | | | |

| I. | **Transportation/Circulation:** | **YES** | **MAYBE** | **NO** |
|---|---|---|---|---|
| 1. | Generation of substantial additional vehicle trips? | | | x |
| 2. | Affect existing parking facilities or demand for new parking? | | | x |
| 3. | Substantial impact upon existing transportation systems? | | | x |
| 4. | Increase in traffic hazards to motor vehicles, bicyclists, or pedestrians? | | | x |
| Assessment: | | | | |

| J. | **Services:** | **YES** | **MAYBE** | **NO** |
|---|---|---|---|---|
| 1. | Affect or result in need for new or altered government-provided fire protection services? | | | x |
| 2. | Affect or result in need for new or altered government-provided security services? | | | x |
| Assessment: | | | | |

| K. | **Environmental Justice:** | **YES** | **MAYBE** | **NO** |
|---|---|---|---|---|
| 1. | Potential to disproportionately affect low income populations or minority populations? | | | x |
| Assessment: | | | | |

## EAPO Checklist for On-Site Environmental Evaluation of Proposed Action

**PROJECT NAME:** Mars Cube One (MarCO) **DATE :** June 17, 2015

**PROJECT CONTACT:** Andrew Klesh **PHONE NUMBER:** (818) 354-4104 **MAILSTOP:** T1710

**PROJECT START:** October 1, 2014 **PROJECT NAME (or TASK PLAN/ORDER NUMBER) and LOCATION:** Mars Cube One (MarCO), JPL

**PROJECT DESCRIPTION:** MarCO would launch 2 6-Unit (6U) CubeSats which would be mounted on the Centaur Second Stage of the InSight Atlas V launch system. The 2 CubeSats would relay InSight EDL information to Earth.

**ENVIRONMENTAL IMPACTS**:

*(Note: "YES" and "MAYBE" responses require explanation in the assessment field at the end of each section, and may require the conduct of additional studies or preparation of additional NEPA compliance documentation.)*

| **A.** | **Geologic:** | **YES** | **MAYBE** | **NO** |
|---|---|---|---|---|
| 1. | Greater than a 10% change in topography or ground surface relief features? | | | x |
| 2. | Any increase in wind or water erosion of soils, either on or off site? | | | x |
| 3. | Changes in deposition, siltation, or erosion that may modify wetlands? | | | x |
| Assessment: | | | | |
| **B.** | **Air:** | **YES** | **MAYBE** | **NO** |
| 1. | Classified as either a New Emission Source or a major modification to an existing source (SCAQMD Regulation XIII)? | | | x |
| 2. | Creation of objectionable odors? | | | x |
| 3. | Alteration of air movement, moisture, temperature, or any changes in climate, either locally or regionally? | | | x |
| Assessment: | | | | |
| **C.** | **Water:** | **YES** | **MAYBE** | **NO** |
| 1. | Disturbance of groundwater? | | | x |
| 2. | Alteration of the direction or rate of ground waters? | | | x |
| 3. | Change in the quantity of ground waters, either through direct additions or withdrawals, or through interception of an aquifer by cuts or excavations? | | | x |
| 4. | Greater than 10% changes in absorption rates, drainage patterns, or the rate and amount of surface runoff? | | | x |
| 5. | Alter the course or flow of flood waters? | | | x |
| 6. | Activities resulting in changes of greater than 10% of Laboratory total potable water use? | | | x |
| 7. | Any construction or other activity in a floodplain or wetland? | | | x |
| 8. | Generate industrial waste water or storm water discharge? | | | x |
| Assessment: | | | | |
| **D.** | **Cultural Resources:** | **YES** | **MAYBE** | **NO** |
| 1. | Project located in a historic district, in or near a historic property, or affects an existing national historic landmark? | | | x |
| 2. | Will Project alter all or part of an eligible structure? | | | x |
| 3. | Project located in an area of suspected archeological resources? | | | x |
| Assessment: | | | | |
| **E.** | **Biological Resources:** | **YES** | **MAYBE** | **NO** |
| 1. | Construction/grading/filling within or adjacent to designated wetlands? | | | x |
| 2. | Reduction of the numbers of any rare or endangered species? | | | x |
| 3. | Construction/grading/filling within open space or grasslands areas? | | | x |
| 4. | Introduction of new species or plants into an area, or impact the normal replenishment of existing species? | | | x |
| 5. | Proposed construction activities in designated critical habitat? | | | x |
| 6. | Propose new landscaping or modify existing landscaping? | | | x |
| Assessment: | | | | |

## EAPO Checklist for On-Site Environmental Evaluation of Proposed Action

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT NAME:** | Mars Cube One (MarCO) | | **DATE :** | June 17, 2015 | |
| **PROJECT CONTACT:** | Andrew Klesh | **PHONE NUMBER:** | (818) 354-4104 | **MAILSTOP:** | T1710 |
| **PROJECT START:** | October 1, 2014 | **PROJECT NAME (or TASK PLAN/ORDER NUMBER) and LOCATION:** | Mars Cube One (MarCO), JPL | | |
| **PROJECT DESCRIPTION:** | MarCO would launch 2 6-Unit (6U) CubeSats which would be mounted on the Centaur Second Stage of the InSight Atlas V launch system. The 2 CubeSats would relay InSight EDL information to Earth. | | | | |

**ENVIRONMENTAL IMPACTS**:

*(Note: "YES" and "MAYBE" responses require explanation in the assessment field at the end of each section, and may require the conduct of additional studies or preparation of additional NEPA compliance documentation.)*

| **F.** | **Noise:** | **YES** | **MAYBE** | **NO** |
|---|---|---|---|---|
| 1. | Noise increase greater than 10% from an existing operation? | | | x |
| 2. | Exposure of people to severe noise levels (> 80 dBA)? | | | x |
| 3. | Increase existing Community Noise Equivalent Level (CNEL) noise contours? | | | x |
| Assessment: | | | | |
| **G.** | **Land Use:** | **YES** | **MAYBE** | **NO** |
| 1. | Substantial alteration of present or planned land use? | | | x |
| 2. | Increase in rate of use of any natural resource? | | | x |
| 3. | Activities resulting in changes of greater than 10% of facility energy consumption? | | | x |
| 4. | Activities resulting in a change in total employment levels greater than 10% ? | | | x |
| Assessment: | | | | |
| **H.** | **Health and Safety:** | **YES** | **MAYBE** | **NO** |
| 1. | Generation of ionizing or non-ionizing radiation? | | x | |
| 3. | Use of pesticides, including insecticides, herbicides, fungicides or rodenticides? | | | x |
| 4. | Confined space entry? | | | x |
| 5. | Risk of exposure to asbestos or lead-containing materials? | | | x |
| 6. | Result in exposure or disturbance of contaminated soil or ground water? | | | x |
| 7. | Use of Class 1 ozone depleting substances (CFCs, TCA, halons)? | | | x |
| 8. | Acquisition, use, or storage of any toxic or hazardous substance? | | x | |
| 9. | Generation of medical (biohazard), hazardous, toxic, or radiological wastes? | | | x |
| 10. | Use, disturbance, or disposal of PCBs? | | | x |
| 11. | Use of toxic gas? | | | x |
| Assessment: | Assembly and test of MarCO hardware would take place inside JPL buildings 103 and 189 and would include the use of hazardous substances and generation of non-ionizing radiation. However, the JPL Systems Safety Office has completed Systems Safety Survey FOS-15-045, and the JPL Occupational Safety Office has completed preOSR 15-3820-149. Both the Systems Safety Survey and preOSR include a safety assessment and personal and facility safety requirements. Thus, the proposed assembly and test of MarCO hardware inside JPL buildings 103 and 189 conducted according to the requirements of the Systems Safety Survey and preOSR would not pose a substantial impact to health and safety. | | | |
| **I.** | **Transportation/Circulation:** | **YES** | **MAYBE** | **NO** |
| 1. | Generation of substantial additional vehicle trips? | | | x |
| 2. | Affect existing parking facilities or demand for new parking? | | | x |
| 3. | Substantial impact upon existing transportation systems? | | | x |
| 4. | Increase in traffic hazards to motor vehicles, bicyclists, or pedestrians? | | | x |
| Assessment: | | | | |
| **J.** | **Services:** | **YES** | **MAYBE** | **NO** |
| 1. | Affect or result in need for new or altered government-provided fire protection services? | | | x |
| 2. | Affect or result in need for new or altered government-provided security services? | | | x |
| Assessment: | | | | |
| **K.** | **Environmental Justice:** | **YES** | **MAYBE** | **NO** |
| 1. | Potential to disproportionately affect low income populations or minority populations? | | | x |
| Assessment: | | | | |