

National Aeronautics and
Space Administration

Headquarters
Washington, DC 20546-0001



JUL 28 2017

RECORD OF ENVIRONMENTAL CONSIDERATION

The National Environmental Policy Act (NEPA) Record of Environmental Consideration (REC) for the Europa Clipper Mission

1.0 Introduction

The National Environmental Policy Act of 1969 as amended (42 U.S.C. 4321, et seq.), requires federal agencies to consider potential environmental impacts during program and project decision-making. NASA must comply with the Council on Environmental Quality (CEQ) regulations for implementing the Procedural Provisions of NEPA [40 CFR Parts 1500-1508], NASA's NEPA regulations [14 CFR Part 1216, Subpart 1216.3], as well as NASA's NEPA policy [NPR 8580.1]. NASA has also prepared an Environmental Assessment (EA) (Ref: Environmental Assessment (Final) for Launch of NASA Routine Payloads, November 2011) to assess the environmental impacts of missions launched with spacecraft that are considered routine payloads from existing launch facilities.

Spacecraft defined as routine payloads utilize materials, quantities of materials, launch vehicles, launch sites, and operational characteristics that are consistent with normal spacecraft preparation and flight activities at Cape Canaveral Air Force Station (CCAFS) and the Kennedy Space Center (KSC), among others. The environmental impacts of launching routine payloads from these sites falls within the range of routine, ongoing, and previously documented impacts that have been determined not to be significant.

NASA program and projects are responsible for complying with NEPA. The Europa Clipper mission is managed by the Planetary Science Division, Science Mission Directorate (SMD) at NASA Headquarters and the mission has been awarded to NASA's FFRDC, JPL, who will design and construct the payload. As such, the attached Environmental and Facility Checklists were completed by the JPL NEPA Manager and reviewed by the Program Executive at NASA Headquarters. The checklists along with criteria defined in NASA's Routine Payload EA were then used to evaluate whether the subject Europa mission qualifies for designation as a NASA Routine Payload.

This REC serves to document NASA review and determination under NEPA for the Europa Clipper mission.

2.0 Mission Description

NASA's planned Europa Clipper mission, currently scheduled to launch no earlier than 2022, would conduct detailed reconnaissance of Jupiter's moon Europa and investigate whether the icy moon could harbor conditions suitable for life.

The mission would place a spacecraft in orbit around Jupiter in order to perform a detailed investigation of Europa -- a world that shows strong evidence for an ocean of liquid water beneath its icy crust and which could host conditions favorable for life. The mission would send a highly capable, radiation-tolerant spacecraft into a long, looping orbit around Jupiter to perform repeated close flybys of the icy moon.

NASA has selected nine science instruments for the mission. The selected payload includes cameras and spectrometers to produce high-resolution images of Europa's surface and determine its composition. An ice penetrating radar would determine the thickness of the moon's icy shell and search for subsurface lakes similar to those beneath Antarctica's ice sheet. The mission would also carry a magnetometer to measure the strength and direction of the moon's magnetic field, which would allow scientists to determine the depth and salinity of its ocean. Gravity measurements would also help confirm the existence of Europa's subsurface ocean. In addition, a thermal instrument would survey Europa's frozen surface in search of recent eruptions of warmer water at or near the surface, while additional instruments would search for evidence of water and tiny particles in the moon's thin atmosphere.

During the nominal mission, the spacecraft would perform approximately 45 flybys of Europa at closest-approach altitudes varying from 1700 miles to 16 miles (2700 kilometers to 25 kilometers) above the surface. Additional information on the spacecraft and planned mission is available at www.nasa.gov/europa.

3.0 Compliance Documentation and Conclusion

The Europa Clipper mission has been reviewed in accordance with the NASA Routine Payload (NRP) 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. The Europa Clipper mission will not utilize radioactive sources or lasers, will not carry any pathogenic organisms, and will not return samples to Earth. In addition, the completed JPL facility checklist confirms that design and construction of the spacecraft is not expected to require any facility construction activity and will conform with environmental permits and environmental management system plans and commitments. The launch vehicle has yet to be selected; however, the candidate launch vehicle/launch site combinations fall within the scope of the EA.

Based upon the analyses, NASA has determined that the Europa Clipper mission fits within the envelope payload characteristics described by the 2011 NRP Checklist and therefore, qualifies as a Routine Payload. Any impacts from the mission are anticipated to be minor and transient.

The program is responsible for reviewing any significant changes in the scope of the payload or activities conducted as part of the Europa mission to ensure they fall within the NASA Routine Payload criteria. If any aspect of the mission falls outside the scope of this REC, additional environmental review and/or documentation will be completed.



Thomas H. Zurbuchen, Ph.D.
Associate Administrator,
Science Mission Directorate

Enclosures:

NASA Routine Payload Environmental Assessment Checklist
JPL Facility Environmental Evaluation Checklist

Evaluation Checklist for Applicability of the NASA Routine Payload Environmental Assessment (NRP EA)

PROJECT NAME: Europa Clipper LAUNCH DATE: NET June 1, 2022

PROJECT CONTACT: Brian Cooke PHONE: 818-393-5881 E-MAIL: 321-560

PROPOSED ACTION The Europa Clipper mission would launch on the Delta IVH, Falcon Heavy, Space Launch System (SLS) or Vulcan from KSC/CCAFS no earlier than June 1, 2022 and place a spacecraft in orbit around Jupiter in order to perform a detailed investigation of the giant

DESCRIPTION: planet's moon Europa.

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.

YES **NO**

A. Sample Return:			
Would the candidate mission return a sample from an extraterrestrial body?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Comment:			
B.			
Would the candidate spacecraft carry radioactive materials in quantities that produce an A2 mission multiple value of 10 or more?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Comment:			
C. Launch Site and Launch Vehicles:			
1. Would the candidate spacecraft be launched on a vehicle and launch site combination other than those listed in Table 1 of this checklist?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Would launch of the proposed mission exceed the approved or permitted annual launch rate for the particular launch vehicle or launch site?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Comment: Baseline LV is the SLS, which is covered under the Final Constellation EIS and the Modified Record of Decision. Europa could also launch on a Delta IV Heavy which is covered under the NRP EA. The Falcon Heavy and the Vulcan launch vehicles are in development.			
D.			
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)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Comment:			
E. Health and Safety:			
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 of this checklist?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2. Would the expected risk of human casualty from spacecraft planned orbital reentry exceed the criteria specified by NASA Standard 8719.14?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
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)?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
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?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
5. Are there changes in the preparation, launch or operation of the candidate spacecraft from the standard practices described in Chapter 3 of the <i>Final Environmental Assessment for Launch of NASA Routine Payloads on Expendable Launch Vehicles</i> dated November 2011?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
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)?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Evaluation Checklist for Applicability of the NASA Routine Payload Environmental Assessment (NRP EA)

PROJECT NAME: Europa Clipper LAUNCH DATE: NET June 1, 2022

PROJECT CONTACT: Brian Cooke PHONE: 818-393-5881 E-MAIL: 321-560

PROPOSED ACTION The Europa Clipper mission would launch on the Delta IVH, Falcon Heavy, Space Launch System (SLS) or Vulcan from KSC/CCAFS no earlier than June 1, 2022 and place a spacecraft in orbit around Jupiter in order to perform a detailed investigation of the giant

DESCRIPTION: planet's moon Europa.

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.

		YES	NO
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 ?		<input type="checkbox"/>	<input checked="" type="checkbox"/>
Comment:			
F. Other Environmental Issues:			
1. Would the candidate spacecraft have the potential for substantial effects on the environment outside the United States?		<input type="checkbox"/>	<input checked="" type="checkbox"/>
2. Would launch and operation of the candidate spacecraft have the potential to create substantial public controversy related to environmental issues?		<input type="checkbox"/>	<input checked="" type="checkbox"/>
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)?		<input type="checkbox"/>	<input checked="" type="checkbox"/>
Comment:			
G. Applicability of the NASA Routine Payload Environmental Assessment (NRP EA):			
Pending approval by NASA, the NASA Routine Payload Environmental Assessment (NRP EA) <input checked="" type="checkbox"/> does <input type="checkbox"/> does not provide adequate coverage for the proposed action as currently described.			
Additional considerations, if any: The baseline LV is the SLS, which is covered under the Final Constellation EIS and Modified Record of Decision. Europa Clipper could also launch on a Delta IV Heavy, covered under the NRP EA. The Falcon Heavy and the Vulcan launch vehicles are in development. The Falcon Heavy is covered under the Kennedy Space Center (KSC) Final Programmatic Environmental Impact Statement for Center-Wide Operations, dated November 2016 and Record of Decision, dated March 10, 2017.			

Individual Completing Checklist:

Date of Completion:

Janis Graham

May 10, 2017

Launch Approval Engineer, JPL

Concurred by NMO NEPA Manager:

Date:



5/25/2017

Steven Slaten, Environmental and Facilities Manager

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.

Data Tables from NASA "Final Environmental Assessment For Launch Of Nasa Routine Payloads On Expendable Launch Vehicles", November 2011

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 ^b
Falcon 9	LC-40	SLC-4E	Omelek	Pad 0	LP-3 ^b
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	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 ^b

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.

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

Structure	<ul style="list-style-type: none"> Unlimited: aluminum, beryllium, carbon resin composites, magnesium, titanium, and other materials unless specified as limited.
Propulsion^a	<ul style="list-style-type: none"> Liquid propellant(s); 3,200 kg (7,055 lb) combined hydrazine, monomethylhydrazine and/or nitrogen tetroxide. 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	<ul style="list-style-type: none"> Various 10-100 Watt (RF) transmitters
Power	<ul style="list-style-type: none"> Unlimited Solar cells; 5 kilowatt-Hour (kW-hr) Nickel-Hydrogen (NiH₂) or Lithium ion (Li-ion) battery, 300 Ampere-hour (A-hr) Lithium-Thionyl Chloride (LiSOCl), or 150 A-hr Hydrogen, Nickel-Cadmium (NiCd), or Nickel-hydrogen (Ni-H₂) battery.
Science Instruments	<ul style="list-style-type: none"> 10 kilowatt radar 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	<ul style="list-style-type: none"> U. S. Department of Transportation (DoT) Class 1.4 Electro-Explosive Devices (EEDs) for mechanical systems deployment Radioactive materials in quantities that produce an A2 mission multiple value of less than 10 Propulsion system exhaust and inert gas venting 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.

Facility Environmental Evaluation Checklist

This checklist is to be completed by the EAPO in coordination with the JPL program/project manager who proposes on-site activities.

Title of Proposed Action: Europa Mission

Description of Proposed Action: The Europa mission would send a radiation-tolerant spacecraft into a long, looping orbit around Jupiter to perform repeated close flybys of the icy moon. The multiple-flyby Europa mission concept was developed in partnership with the Johns Hopkins University Applied Physics Laboratory. NASA has selected nine science instruments for the mission. The three JPL-developed instruments would include: REASON- a radar instrument operating at 9 MHz and 60 MHz; ICEMAG, a magnetometer that would include an enclosed laser for two of the Scalar Vector Helium magnetometer heads; and MISE - an IR spectrometer.

Start Date and Duration: 2016

Today's Date: May 15, 2017

Name of Prog/Project Manager: Barry Goldstein

Phone: 4-6462

Facility Location: JPL Oak Grove GDSCC TMF

Proposed Action Bldg/Room:
TBD

Environmental Impacts (Check appropriate box and provide sufficient details for assessment. Explain any "Yes" and "Maybe" responses in the Assessment field on page 3.)

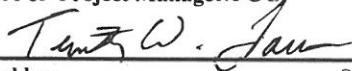
A. Geologic	Yes	No	May be
1. Would the proposed action induce erosion (Water/Wind) either on- or off-site?		x	
2. Would the proposed action affect surface stability?		x	
3. Would the proposed action affect agricultural lands?		x	
B. Water	Yes	No	May be
1. Would the proposed action affect a natural body of water?		x	
2. Would the proposed action alter storm water flow?		x	
3. Would the proposed action result in a >10% change of facility potable water use (>250GPM)?		x	
4. Would the proposed action impact chemical quality (pH, dissolved solids, organics, etc.) of wastewater or stormwater?		x	
5. Would the proposed action impact physical quality (temperature, suspended solids, etc.) of wastewater or stormwater?		x	
6. Would the proposed action require a modification to the existing stormwater permit?		x	
7. Would the proposed action require a modification to the existing industrial wastewater permit?		x	
C. Air	Yes	No	May be
1. Would the proposed action generate objectionable odors?		x	
2. Would the proposed action release toxic substances?		x	
3. Would the proposed action release particulates?		x	
4. Would the proposed action be classified either a New Source Emission or a major modification to an existing source (SCAQMD Regulation XIII)?		x	
D. Natural Resources	Yes	No	May be
1. Would the proposed action affect an undisturbed natural area?		x	
2. Would the proposed action affect game animals and fish?		x	
3. Would the proposed action affect threatened or endangered species?		x	
4. Would the proposed action affect nesting birds?		x	
5. Would the proposed action affect a critical habitat?		x	
6. Would the proposed action affect protected trees (e.g.: oak)?		x	
E. Land Use	Yes	No	May be

1. Would the proposed action affect floodplains/wetlands?		X	
2. Would the proposed action affect off-site land use?		X	
3. Would the proposed action affect on-site land use?		X	
4. Would the proposed action affect aesthetics?		X	
F. Cultural Resources	Yes	No	May be
1. Would the proposed action affect NRHP-Listed Properties?		X	
2. Would the proposed action affect properties eligible or potentially eligible for the NRHP?		X	
3. Would the proposed action affect known historic landmarks?		X	
4. Would the proposed action affect known and/or potential archeological areas?		X	
G. Socio-Economic/Environmental Justice	Yes	No	May be
1. Would the proposed action affect regional employment?		X	
2. Would the proposed action disproportionately affect low income or minority populations?		X	
H. Noise	Yes	No	May be
1. Would the proposed action expose people to severe noise levels (>80dBA)?		X	
2. Would the proposed action increase existing community noise contours?		X	
I. Health and Safety	Yes	No	May be
1. Would the proposed action generate ionizing or non-ionizing radiation?			X
2. Would the proposed action use pesticides, insecticides, herbicides, fungicides, or rodenticides?		X	
3. Would the proposed action require entry into a confined space?		X	
4. Would the proposed action include the use, acquisition, or storage of toxic or hazardous substances?			X
5. Would the proposed action generate medical, hazardous, toxic, or radiological waste?			X
J. CERCLA	Yes	No	May be
1. Would the proposed action affect existing CERCLA infrastructure (e.g.: wells)?		X	
2. Would the proposed action be located in an area of known future CERCLA activity?		X	
3. Would the proposed action result in exposure or disturbance of contaminated soil or groundwater?		X	
K. Activity/Systems	Yes	No	May be
1. Would the proposed action reduce parking?		X	
2. Would the proposed action affect access to utility or infrastructure support systems?		X	
3. Would the proposed action affect roadway transportation systems?		X	
4. Would the proposed action increase hazards to motor vehicles or pedestrians?		X	
5. Would the proposed action require the acquisition or storage of solid waste storage containers?		X	

Assessment:

I. Health and Safety # 1, 4 and 5 – The Europa mission is currently in Phase B (and not implementation). Potential on-site technical facilities have been booked and reserved in preparation for integration and test, currently scheduled to occur in Phase D. Once integration and test of the three JPL instruments and spacecraft begins, hazardous substances would be used and hazardous waste and non-ionizing radiation would be generated. JPL has processes and procedures in place to fulfill health and safety requirements. Moreover, a Systems Safety Engineer has been assigned to the Europa mission and will begin the required safety assessments during phase C, as appropriate, to more accurately assess and document health and safety matters.

Signature of Project Manager/POC:



Date:

5/22/2017

Prepared by:
(JPL EAPO) Faustino Chirino

Signature:



Date:

May 22, 2017

Approved by: Steve Slaten

Signature:



Date: 5-22-17

(Environmental and Facilities Manager,
NASA Management Office, JPL)