NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MISSION STATUS REPORT

Europa Clipper Mission Status

Quarterly systems review and trajectory analysis for the Jupiter-bound spacecraft, covering vehicle health, science instrument readiness, and upcoming milestones.

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Mission Overview

The Europa Clipper spacecraft launched successfully on October 14, 2024 aboard a SpaceX Falcon Heavy from Kennedy Space Center Launch Complex 39A. The spacecraft is currently in its interplanetary cruise phase, en route to Jupiter via a Mars gravity assist.

The mission will conduct a detailed survey of Jupiter's moon Europa, investigating whether the icy moon could harbor conditions suitable for life. The spacecraft carries nine science instruments designed to study Europa's ice shell, ocean, composition, and geology.

Europa Clipper is the largest planetary spacecraft NASA has ever built, with a solar array wingspan of over 30 meters. The mission represents a cornerstone of NASA's Ocean Worlds exploration strategy and builds on decades of observations from Voyager, Galileo, and the Hubble Space Telescope.

> **Key Update:** All nine science instruments have completed their initial checkout and calibration sequences. No anomalies detected during the commissioning phase. The spacecraft is performing above expectations across all subsystems.

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Spacecraft Health

All primary systems are operating within nominal parameters. The power subsystem is generating 12% above predicted output due to favorable solar array orientation during the early cruise phase.

Propulsion System

The bipropellant propulsion system completed its first trajectory correction maneuver (TCM-1) on November 2, 2024. Delta-v delivery accuracy was within 0.3% of planned values, demonstrating excellent engine performance.

- **Main engine:** 2,000 N bipropellant thruster — nominal, 1 firing to date
- **Attitude control:** 16x 4.5 N monopropellant thrusters — all 16 operational
- **Propellant remaining:** 98.2% of total capacity (2,724 kg of 2,774 kg loaded)
- **Next maneuver:** TCM-2 scheduled for March 2025, 15 days before Mars flyby

Power & Thermal

The solar arrays are generating 860W at current heliocentric distance (1.42 AU), exceeding the predicted 768W by a comfortable margin.

- **Solar array output:** 860W (12% above model)
- **Battery capacity:** 35 Ah — fully healthy
- **Thermal zones:** All 14 zones within limits

Communications

The high-gain antenna subsystem is performing above expectations, achieving data rates of 78 kbps at current Earth distance.

PARAMETER	VALUE	STATUS
Downlink rate	78 kbps	Above nominal
Uplink rate	2 kbps	Nominal
Signal margin	+3.2 dB	Healthy
DSN coverage	14 hrs/day	As planned
Data volume returned	1.2 TB	On track

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Science Instrument Status

All nine instruments completed their commissioning sequences during the first 90 days of flight. Each instrument team has confirmed nominal performance and readiness for the Mars flyby observation campaign.

INSTRUMENT	TYPE	STATUS	NOTES
REASON	Ice-penetrating radar	Nominal	Antenna deployed successfully
EIS	Camera system	Nominal	Both NAC and WAC calibrated
MISE	Spectrometer	Nominal	Spectral response verified
E-THEMIS	Thermal imager	Nominal	Cooler at operating temp
Europa-UVS	UV spectrograph	Nominal	Stellar calibration complete
MASPEX	Mass spectrometer	Nominal	Background counts as expected
PIMS	Plasma instrument	Nominal	Solar wind measurements begun
SUDA	Dust analyzer	Nominal	First interplanetary dust detected
Magnetometer	Magnetic field	Nominal	Boom deployed, calibrated

Note: The SUDA dust analyzer has already detected its first interplanetary dust particles, providing an early science bonus during the cruise phase. Data is being shared with the Interplanetary Dust community.

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Trajectory Analysis

The spacecraft is on course for its Mars gravity assist on March 1, 2025. Current trajectory analysis shows arrival at Jupiter in April 2030, well within the planned arrival window.

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Trajectory Parameters (as of 2025-02-01)
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Heliocentric distance:  1.42 AU
Velocity (helio):       32.6 km/s
Earth distance:         0.89 AU
Light time (one-way):   7.4 minutes

Mars flyby:             2025-03-01
Closest approach:       500 km altitude
Expected delta-v:       2.1 km/s gain

Jupiter orbit insert:   2030-04-11
Europa flybys begin:    2031-01-15
Total Europa flybys:    49 planned
Mission end:            2034-09-30
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The navigation team reports trajectory knowledge accuracy of ±2 km at Mars closest approach, well within the ±50 km requirement. No additional deterministic maneuvers are required before the Mars flyby, though a statistical TCM-2 is planned as a precaution.

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Risk Register

Three active risks are being tracked, all rated low or medium severity. Two risks have been retired since the last quarterly review following successful instrument commissioning.

RISK ID	DESCRIPTION	SEVERITY	TREND
R-015	Solar array degradation from micrometeoroids during Mars flyby	Medium	Stable
R-022	Jupiter radiation belt model uncertainty affecting instrument lifetime	Medium	Improving
R-031	DSN scheduling conflicts with Mars Sample Return campaign	Low	Stable

R-015 Mitigation: The spacecraft will be oriented to minimize solar array cross-section during Mars closest approach. Analysis shows risk of significant damage is less than 0.1%.

R-022 Mitigation: Updated radiation models incorporating 3 additional years of Juno in-situ data show 15% lower flux than original design estimates. Instrument shielding margins are now considered conservative.

R-031 Mitigation: Backup ground station agreements with ESA's Estrack network (New Norcia and Cebreros) have been formalized for critical mission phases.

> **Assessment:** Overall mission risk posture remains low. No schedule or budget impacts anticipated from current risk items. Two risks (R-008: launch vehicle performance, R-011: solar array deployment) were retired following successful launch and commissioning.

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Next Steps

The following milestones are planned for the next two quarters:

1. **TCM-2 execution window** — March 14–16, 2025
2. **Mars gravity assist flyby** — March 1, 2025, with science observations planned by EIS, Europa-UVS, and MISE during closest approach
3. **Post-flyby trajectory assessment** — March 10, 2025
4. **Jupiter approach science planning workshop** — April 14–18, 2025 at JPL
5. **Annual comprehensive performance review** — June 2025
6. **Flight software update v2.1 upload** — July 2025, adding enhanced autonomous fault protection for Jupiter operations
7. **Publish updated flyby sequence** — July 2025, incorporating latest ephemeris data