European Space Agency Partnership and Contribution

Version 1, March 29, 2023

As stated in the AO, NASA and the European Space Agency (ESA) have formalized a partnership for the NF5 mission that provides an optional contribution(s). The contribution(s) may include hardware procured by ESA from European vendors and/or other services, such as ground segment support, to be considered under ESA responsibility. This document provides a list of various hardware contributions in four cost bins. Costs for the items will not be known until ESA begins its procurement process. For this AO, proxy costs are instead used and denoted with one to four "€" signs (with a larger number of "€" signs indicating a higher cost). Proposers may choose up to four items from this list totaling a maximum of six "€" signs for all items chosen.

The links in the "Data Sheet" column offer examples of the characteristics and performance of the hardware types listed and are not an exhaustive list. There are other European suppliers for the hardware types listed, and the inclusion of these data sheets does not denote any preference by ESA among those potential suppliers. The inclusion of these data sheets does not indicate that a specific hardware item or vendor has been selected by ESA, and procurement of selected items would follow standard ESA procurement rules.

Proposers should direct questions to the New Frontiers Program Scientist given in Section 6.1.5 of the AO.

Subsystem	Equipment	Proxy Cost[1]	Baseline Mass [kg]	Baseline Performance	Data Sheet(s)[2]	Reference Mission(s)	Remarks
Communication (TT&C)	Transponder	€€€	3	X/X or X/X/Ka band	TAS TP	Bepi-Colombo, Juice, ExoMars, Solar Orbiter, JUNO, JWST	May include equipment for Radio Science
		€€	2	S-band	TAS-TPS	PACE, Roman Space Telescope	
	High Gain Antenna (HGA)	€€€	depend on size		TAS HGA	Cassini, JUICE, MEX.VEX	May include antenna pointing mechanism (APM)
	Medium Gain Antenna (MGA)	€€-€€€			Beyond gravity		
	Low Gain Antenna (LGA)	€	0.5	X or S band			
	RF distribution unit (RFDU)	€	2 to 4				If mounted on a single panel
	Travelling Wave Tube Amplifier (TWTA)	€€		X or Ka-band	TAS TWTA	NH Pluto Kuiper Belt, Roman Space Telescope, Bepi-Colombo, JUICE	
Electrical Power	Solar Arrays[3]	€€€-€€€€	depends on size	30% efficiency GaAS or low T low Solar intensity cells	ADS-NL TAS SA STI leonardo	JUICE, BepiColombo, Solar orbiter	Limited to small panels with clear and simple interfaces
	Battery	€-€€	5-50 kg	Li-Ion cells		LRO, SDO, Bepi-Colombo, Juice, ExoMars, Solar Orbiter, JUNO	excludes power conditioning & distribution unit (PCDU), RTG or RHUs
Avionics	Remote Terminal Unit	€€€	5-8 kg	for thermal and/or			

Subsystem	Equipment	Proxy Cost[1]	Baseline Mass [kg]	Baseline Performance	Data Sheet(s)[2]	Reference Mission(s)	Remarks
	(RTU), but "non-smart"			propulsion control			
Propulsion	He Tanks	€					Could provide the entire subsystem (chemical) if mounted on a single panel
	MON Tanks	€	dep on size	200 to 1500 lt	Ariane Group 1 Ariane Group 2 MT Aerospace OHB Propulsion		
	MMH Tanks	€	dep on size	200 to 1500 lt			
	Main engine (chemical)	€		400-N thrust, 320 s Isp			
AOCS	Star Tracker	€€	2		JenaOptronics Sodern TERMA leonardo	JUNO, NH Pluto Kuiper Belt, Insight, LRO, Roman Space Telescope, Orion	Excludes the full AOCS system, excludes software contributions
	Coarse Sun Sensor	€	0.5		Bradford		
	Reaction Control System (thruster)- see propulsion	€€-€€€			Ariane Group		
	Reaction wheels	€€			Collins Aerospace astrofein		
	Momentum wheels	€€					
	Rate sensor	€€-€€€			Innalabs	PLATO	
GNC	NavCam	€€€					
Mechanisms	Hold Down and Release	€					

Subsystem	Equipment	Proxy Cost[1]	Baseline Mass [kg]	Baseline Performance	Data Sheet(s)[2]	Reference Mission(s)	Remarks
	Mechanism (HDRM)						
	Antenna Pointing Mechanism (APM)	€€					
Thermal	Loop Heat Pipes (LHP)	€	depends on length	~100 W cooling	iberespacio.es	XRISM	
Structure	Secondary panels (associated to other provisions If needed)	€-€€					Not the primary structure
Ground Segment	Support with ESTRACK 35m antenna coverage	€€€					Scientific support

[1] "€" signs are for indication purpose only and denote proxy costs. True costs depend on required model philosophy, detailed performance, etc.

[2] The links in the "Data Sheet" column offer examples of the characteristics and performance of the hardware types listed and are not an exhaustive list. This information does not indicate that a specific hardware item or vendor has been selected by ESA.

[3] Solar panels contributions might be possible, but limited to small size (e.g. excluding a large panel for deep space missions), with simple and well defined interfaces and environmental conditions only.

General Remarks

1. Total chosen contribution(s) should not exceed a total of 4 items from the list.
2. Total proxy cost of contribution(s) should not exceed 6 €-signs (given in Proxy Cost column, added up).

3. Generally speaking the contributions should be based on procurement of recurring units with high TRL (excluding targeted developments), in order to avoid becoming a schedule driver or being on the critical path.

Acronyms

GNC Guidance and Navigation
MON Mixed oxides of nitrogen
MMH Monomethyl Hydrazine
TT&C Telemetry, Tracking & Commanding