ESA/PB-HME/EUB(2023)17, rev.1
[ESA/PB-HME(2023)17, rev.1]
Att: Annex
Paris, 30 August 2023
(Original: English)

EUROPEAN SPACE AGENCY

HUMAN SPACEFLIGHT, MICROGRAVITY AND EXPLORATION PROGRAMME BOARD

Small Missions Studies for Exploration

Summary

This revised document reflects the comments made by delegations at the occasion of the May PB-HME meeting and the informal PB-HME workshop early July on the small missions initiative and selection process. The proposed approach relies on a first mission targeting the Moon, to be implemented as a pilot. The proposed implementation relies on a stepped approach process, starting by a dedicated Announcement of Opportunity call via the Open Space Innovation Platform (OSIP) in Q3 2023. The collected ideas will be assessed via a set of criteria related to the exploration relevance, programmatic aspects and technical feasibility including potential to support commonalities between activities at different destinations. The process foresees to continue with a set of pre-Phase A studies, a reduced (two) Phase A/B1 studies or equivalent in Period 3 to enable informed decisions at CM25 for the implementation of one (1) small mission (The pilot) in Period 4 and beyond. Based on the lessons learnt from this pilot, other small missions targeting the other exploration destinations are expected to be investigated in future E3P Periods.

The updated timeline takes into consideration Delegations' comments to give more time to the potential bidders to prepare their proposals.

Required Action

The Human Spaceflight, Microgravity and Exploration Programme Board is invited to take note of the content of the document and provide comments and guidance on the proposed approach.

Next Steps

Pending the feedback from the Participating States, it is proposed to start the preparation of a dedicated Announcement of Opportunity call / Call for Proposals via the Open Space Innovation Platform (OSIP) in Q3 2023 dedicated to the Small Mission Pilot.

Page intentionally left blank

1. Introduction and Objectives

Small Missions offer a programmatic opportunity for the Participating States with a small to medium contribution to the Terrae Novae Programme to become more visible actors in the implementation of the ESA exploration strategy. Small missions could play an important role in preparing the way for larger Exploration missions.

The ESA exploration strategy[1] has the objective to lead Europe's human journey into the Solar System using robots as precursors and scouts, and to return the benefits of exploration back to society. Small missions can contribute to the implementation of the goals of the Terrae Novae roadmap and in particular:

- Prepare elements on the critical path leading to the horizon goal of Europeans to Mars
- Close technology gaps in areas relevant to exploration such as power, surface mobility, propulsion, ISRU, and entry, descent and landing technologies needed for future missions and exploration infrastructure
- Increase scientific knowledge of the Moon and Mars and to use Low Earth Orbit for scientific research and as technology test bed

Ideas for small missions will therefore be evaluated on the basis of how they answer to the different exploration objectives that could include knowledge increase (science), technical and economic innovation, international cooperation and inspiration, in Annex A the proposed selection criteria are presented.

Areas for scientific activity in Terrae Novae are reported in the Strategy for Science at the Moon[2] and more recently the Draft Roadmap for Implementation of the SciSpaceE Strategy[3]. In summary any scientific investigations on small mission should be focussed on:

- Understanding environments in deep space, at the Moon and at Mars and the effects on technology and biology of exposure to these environments
- Observing, predicting, and mitigating changes that human activity will introduce to these environments
- Finding, characterising and quantifying potential resources and understanding how local environments affect resource extraction processes
- Finding life and understanding its and origins

[1] ESA/C(2022)108, Terrae Novae 2030+ Strategy Roadmap Executive Summary
[2] Strategy for Science at the Moon (ESA/PB-HME(2019)11, rev.1)
[3] Draft Roadmap for Implementation of the SciSpacE Strategy (EUB/W55-07)

- Preparing future use of Moon and Mars for longer term; scientific investigations and other applications

For technology innovation, the relevant references are the ESA Technology Strategy [4], E3P technology push requirements [5], the In-Situ Resource Utilisation (ISRU) Campaign Technology Roadmap [6] (related to the ESA Space Resource Strategy issued in 2019 and planned to be updated in May 2022) and the Global Exploration Roadmap (GER) critical technologies [7].

Economic objectives will also be evaluated. For example, does a proposal for a small mission create a new business, assist start-ups or allow existing industries to grow? All these possibilities will be positively considered.

International cooperation may take several forms. It could mean involvement of a few ESA Member States working together on a common proposal; the creation of a new partnership with an international Partner, especially of emerging space powers; or that the proposal exploits a 'piggy-back' (ride share) launch on one of the already planned missions in the Artemis programme.

Positive factors contributing to inspiration goals could involve universities research laboratories or even schools becoming part of the programme and thus attracting and training the next generation. Proposals containing elements of strong outreach and public engagement would be especially welcomed.

2. Definition of Small Missions for Exploration

The possible destinations of small exploration missions are defined to be Low Earth Orbit (LEO), the Moon or Mars in accordance with the ESA exploration strategy. Even though it is proposed to focus the first mission to be seen as a pilot, on the Moon, the other destinations are detailed further below.

Applications such as Earth observation, telecommunications and navigation or scientific goals falling directly under the remit of the ESA Science Programme would be excluded.

Small missions to LEO could include platforms to demonstrate exploration technologies or to develop the LEO economy (such as in-orbit research or manufacturing).

Small Missions to the Moon could include fly-by satellites, orbiters and surface assets (landers/rovers/penetrators etc.).

---

[4] ESA Technology Strategy (V1.2 September 2022)
[5] European Exploration Envelope Programme (E3P) Exploration Preparation Research and Technology (ExPeRT) element Technology Push Requirements (ESA-E3P-EXPE-RS-003) May 2020
[6] ISRU Campaign Technology Roadmap 2020 (ESA-E3P-ISRU-MO-001)
[7] GER Critical Technology Needs 2019, planned to be updated to reflect the lunar surface architecture introduced with the 2020 and 2022 GER supplements

Small Missions to Mars could include fly-by satellites, orbiters and surface assets (probes/rovers/penetrators etc.).

For what concerns small missions to the Moon, opportunities provided by rideshare launches, where the spacecraft is a secondary payload or one of a cluster of small payloads, have been already assessed in Terrae Novae Period 2 and the overall cost of a small orbital mission to the Moon could be below 50M€.

Small missions to Moon would be encouraged to consider the use of communication resources such as Lunar Pathfinder (where ESA has already secured data services) and in due course, Moonlight communications and navigation services that are expected to be available before the end of this decade.

Regarding Mars missions, during Period 2 of E3P, the Executive has performed a CDF study [8] and several pre-Phase A studies to examine what low-cost missions to Mars could look like. The studies concentrated on self-standing missions that must perform their own Mars Orbit Insertion (MOI) and data downlink. The Agency's conclusion, confirmed by other agencies is that low-cost missions to Mars (<150M€) are not credible without a basic communications relay and propulsive transfer services being available to perform MOI.

3. Proposed Implementation Approach

3.1 Guiding principles

Create new opportunities for the targeted players
It is proposed that the Large System Integrators in the larger contributing states to the programme will be excluded from being the lead proposer of a mission concept, although being able to participate as subcontractors.
It is proposed that subsidiaries of the LSIs operating in the small and medium contributing States to the programme shall not be excluded from responding to the Announcement of Opportunity.

Participation of SMEs, mid-caps and research institutions shall be positively encouraged.

Ensure a full competitive approach for mission selection
Mission outlines will be assessed on their clarity, credibility and completeness when competing for selection.

[8] Small Mars Mission Architecture Study (SMARTieS); CDF Study Report CDF-205(A), April 2020

Leverage previous initiatives and AOs

Previous initiatives and announcement of opportunity such as the LUCE Sysnova in 2017 have already collected several ideas for small missions for Exploration. However, since new criteria will be used it is necessary that interested consortia will need to apply again to this Announcement of Opportunity / Call for Proposals.

3.2. Implementation steps and first call

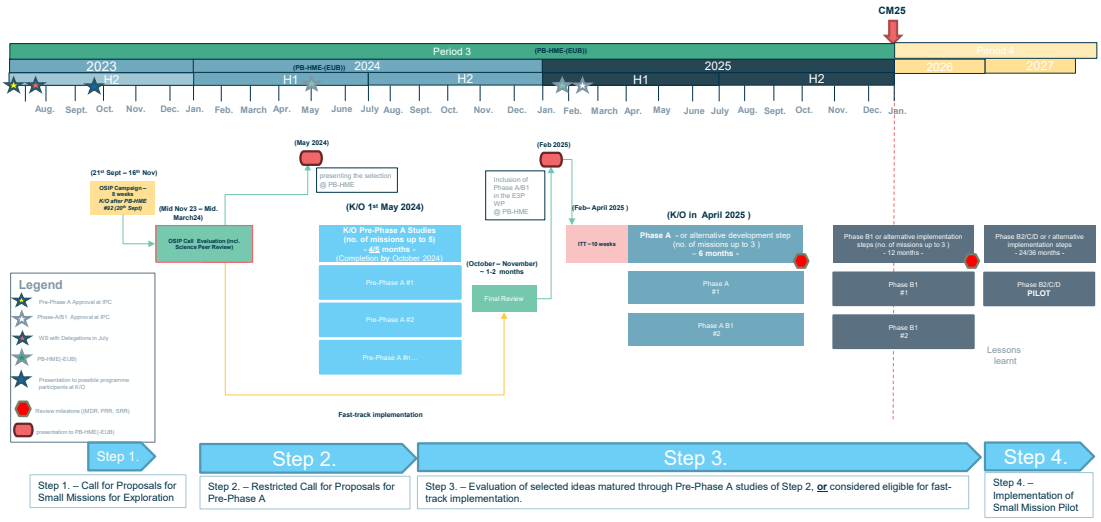

Figure 2. - Notional timeline for the implementation of Small Missions

We are proposing to open the OSIP campaign for the first call of Small Mission for Exploration limiting it to the Moon, further calls will aim for other destinations. The OSIP call is proposed to be started on 21 September 2023 with a virtual Workshop open to industries, research centres and all the potential bidders.

Any scientific investigations on small mission of the first call should be focused on (not listed in particular order):

- Understanding environments in deep space, at the Moon and at Mars and the effects on technology and biology of exposure to these environments
- Observing, predicting and mitigating changes that human activity will introduce to these environments
- Finding, characterising and quantifying potential resources and understanding how local environments affect resource extraction processes
- No specific indication in term of technologies areas will be provided in the call

The implementation of the Small Missions for Exploration initiative will follow a four-step approach as depicted in Figure 2 above. A notional timeline is included.

Step 1: Preliminary Stage

The **step 1** of the proposed procedure is composed by an Announcement of Opportunity call / Call for Proposals for Small Missions for Exploration that will be open on OSIP and will ask for submission of mission ideas (outline proposals). The call will remain open for 8 weeks.

The solicitation documents of a Call for Proposal for Small Missions for Exploration will include the following:

- the step-by-step description of the procedure that will lead to the submission and evaluation of outline proposals
- reference to the Open Space Innovation Platform ('OSIP') where the outline proposals shall be submitted and all communication related thereto is to take place
- the precise definition of the scope of the call for Small Missions for Exploration as set out above
- the definition of the maximum budget for an individual Small Mission;
- the evaluation criteria to be applied to the evaluation of 'outline proposals' (step 1 of the procedure) as well as, as far as possible elements of what could be those evaluation criteria to be applied in the further step of the process;
- a simple template for proposers to use in preparing their submission, ensuring that all proposals are in a common format
- a strict page limit for initial proposals

The solicitation documents will explain the level of information that are required to satisfy the criteria for evaluation of the outline proposal (exploration relevance) and for the evaluation of the full proposal matured through a pre-Phase A (technical and programmatic feasibility for which for example, a Technology Development Analysis and a Design and Development plan will be required).

The proposers will not be required to include in the outline proposal the information related to the technical and programmatic aspects. Nevertheless, if this information is available, they can be provided in annexes to the proposal template.

In the case the proposer will rely on complementary national funding a letter of support is required to be included in the outline proposal.
The evaluation of the outline proposals will be conducted based on criteria that will evaluate the exploration relevance of the submitted ideas.

It is anticipated that following the evaluation, a group of 3-5 (TBC) ideas will be selected to enter into the second step.

The approach to the subsequent steps will be discussed with the Industrial Policy Committee; at this stage the Executive would propose an implementation as follows:

Step 2: Restricted Call for Proposals for pre-Phase A

Following step 1, a number of bidders will be requested to submit through a Pre-Phase A like activity their full proposals through a restricted Call. The pre-Phase A activities aim in particular to identify and assess critical technologies of the proposed mission, define a design and development plan and provide the cost to completion including all operations costs.

Step 3: Phase A/B1 for selected proposals

Step 3 starts with the evaluation of the selected ideas matured though pre-Phase A studies of step 2 (or already submitted in the announcement of opportunity / Call for Proposals with all the details in step 1 and considered eligible for fast-track implementation – see below). A full evaluation will be performed on the basis of the published criteria for technical and programmatic feasibility.

A re-assessment of the exploration relevance (already performed as part of step 1) could be performed in the case that the proposer has introduced changes in the mission objectives during the execution of the step 2. The evaluation process will be concluded with a prioritisation list. A fast implementation frame will be discussed with IPC taking due account of the variety of the activities themselves and of the implementation approaches, so that on the basis of the funding availability for phase A/B1 a tendering process for 1 to 2 (tbc) Phase A/B1 can be swiftly initiated following the prioritisation (assumed to be in direct negotiation given the context) with the top ranked (1-2 tbc) proposers.

However, a classical Phase A/B1 shall not be the only development process that is envisaged for the maturation of Small Missions. The Announcement of Opportunity would invite the proposers to consider different implementation schemes that could include (but not limited to) commercial partnerships or internal/private/national co-funded activities where ESA could provide *inter alia* technical expertise, specialist resources and/or test facilities but not the full development costs.

The proposers would be invited to elaborate possible development approaches that could be different from the classical one that foresees a Phase A/B1 followed by Phase B2/C/D/E. An example already being implemented in the Terrae Novae programme is Lunar Pathfinder. This small lunar satellite is being developed by private industry under a commercial partnership with ESA.

Contracts or other commercial instruments would be put in place in Period 3. In the case that a tendering process with one of the selected proposers will not be successful a new tendering process will be initiated with the next proposer in the prioritisation list.

It could be that a proposer has already submitted in step 1 all sufficient information required for the evaluation of the technical and programmatic feasibility of the idea. If the idea is considered to be outstanding in terms of the criteria identified above, and affordable in terms of financial aspects (perhaps due to the availability of complementary non-ESA funding), the Executive may propose to Participating States to fast track the project implementation.

The target is to conclude the Phase A part of the step 3 in time to collect conclusions and information for the preparation of CM25, Phase B1 will be concluded in Period 4.

Step 4: Implementation of Pilot for Small Mission decided at CM25

A proposal for implementation of single Pilot mission will be elaborated in the programme proposal for CM25 based on the preliminary results of the Step 3 (Conclusion of Phase A). In case of a positive decision and funding availability, the Phase B2/C/D or an equivalent development process for a Small Mission for Exploration will be started in Period 4 of Terrae Novae (Step 4) after the completion of Phase B1.

Evaluation Process

It is proposed that the assessment of the ideas for Small Missions will be conducted by a small multi-disciplinary team within the Agency taking full benefit of the pre-procurement process foreseen for the Calls on OSIP. This team would be complemented for scientific considerations by experts from the ESA science advisory structure including HESAC members and nominations of HESAC. The Small Missions initiative will be presented at August HESAC meeting. The existing external panel supporting the evaluation of E3P Commercial Partnerships would be used to assess economic and commercial aspects of proposals as well as benefitting from the experts from the Commercialisation Department. Experts from the ESA education programme would be involved if necessary.

4. Conclusion and Next Steps

Pending the feedback from the Participating States, it is proposed to release an Announcement of Opportunity call/Call for Proposals via the Open Space Innovation Platform (OSIP) in Q3 2023 dedicated to a pilot of a small mission.

The generic approach for small missions in E3P will be presented to the PB-HME and the Industrial Policy Committee when the result of the pilot are available (e.g at the pilot FAR).

Annex A – Selection Criteria for Small Mission for Exploration initiative

In the following table the selection criteria for Small Missions for Exploration initiative are presented.

The proposed selection criteria have been derived from the selection criteria adopted in 2022 for the identification of candidates for Phase A/B1 studies of “large” missions.

Some selection criteria will be applied at the time of the OSIP call to identify the best mission concepts that could enter into a Pre-Phase A and at the end of the Pre-Phase A to identify the concepts that will enter into a Phase A/B1.

#	Criterion	#	Criterion encompasses	Selection at OSIP	Selection for A/B1 Studies
1	Exploration Scientific / Exploration Content	1.1	Does the mission concept address an important problem or challenge within the priority areas?	✓	☑
		1.2	Is there a clear scientific justification and motivation provided for the proposed mission objectives?	✓	☑
		1.3	What are the mission data products and what extent will they result in outcomes, which are incremental or radical/disruptive?	✓	☑
		1.4	Will the outcomes of the mission provide benefits to Earth or space exploration?	✓	☑
		1.5	Are the mission concept and the methods applied adequately developed, and traceable to the identified objectives and hypotheses?	✓	☑
		1.6	Does the applicant acknowledge scientific risks and suggest mitigation?	✓	☑
		1.7	Does the applicant have appropriate background and expertise for this proposed mission?	✓	☑
2	Technology Feasibility / Technology Readiness	2.1	Are all critical technologies (including those of the payload) and their corresponding and projected TRL identified?		☑
		2.2	Are necessary activities for raising (by the end of Phase B2) TRL, their duration and responsible entities shall be identified?		☑
		2.3	Is the mission free from non-European mission-enabling or critical technologies? / All non-European technologies, if any, shall be identified.		☑
		2.4	Does the applicant acknowledge technical risks and suggest mitigation?		☑
3	General Programmatics	3.1	Is the proposed mission compatible with the Terrae Novae Period 4 budget corridor ?	[✓]	☑
		3.2	Is the background, capabilities and facilities of the consortium elaborated and deemed adequate?	[✓]	☑
		3.3	Are there measurable benefits for the purpose of the specific mission.		☑
		3.4	Has a risk analysis of the programmatic (not technical) aspect been performed?		☑
4	Economic Objectives	4.1	Does the mission enhances Startups, universities and/or schools participations within the programme?		☑
		4.2	Does this mission create new businesses or help existing businesses to grow?		☑
		4.3	Does the proposal show that the project would develop skilled workforce?		☑

Table 1 Selection criteria

✓ Selection for Pre-Ph.A

[✓] At level required (e.g. ROM Cost) for selection for Pre-Ph.A

☑ Selection for Ph.A/B1 (inc. outcome of / update from Pre-Ph.A)