

## NASA Response to Draft Discovery 2019 AO Feedback

### Launch Vehicle

Please provide the LV performance class curves for each level corresponding to allowable cost-cap adjustments.

Please provide the cited ELV Launch Services Information Summary document, which is missing from the program library. Key information includes fairing guidelines (i.e., volume & s/c positioning) and performance related assumptions (e.g., adapter/sep-ring interface assumptions for each performance curve; design load guidelines).

The ELV information is needed urgently so that this critical information can be used to complete the proposal designs. The required information includes LV Capability Curves, 4m and 5 m fairing guidelines (volume & s/c positioning) & performance related assumptions (e.g., adapter/sep-ring interface assumed for the given performance curves), as well as design load guidelines & some listing (or point of contact) of assumed standard services. Please provide this information as soon as possible.

Will ELV performance specification provided by NASA be updated in this AO? Or, is the information the same as what was provided for recent New Frontiers and the previous Discovery? The launch services document seems to be missing from library.

***NASA Response: The ELV Launch Services Information Summary document is being finalized and will be posted in the Program Library as soon as it is ready and no later than the release of the final AO.***

Please identify the NASA point of contact for standard launch services.

***NASA Response: The launch services point of contact will be listed in the final AO when it is released.***

Table 3 on page 53 provides the “Cost deltas for launch service in \$M” for the 2025-26 LRD. Do these same values apply to the 2028-29 LRD?

***NASA Response: Yes, the value for the first LRD should be used for the second LRD. A statement to this effect will be inserted into the final AO.***

The LV credit inflated from the 2014 was expected to be \$16M x 1.11 = \$17.8M, but it is \$10M. It is unclear why this change has been made. Please modify it to more accurately represent past benefits and likely contracts?

***NASA Response: The cost deltas for launch services shown in Table 3 are defined based on a variety of factors, including but not limited to inflation since previous AOs.***

If an upper stage (such as the in-development ULA ACES) is incorporated into the science spacecraft what portion is paid for the launch services and what portion comes under the mission cap? (<https://yellowdragonblog.com/2017/12/16/ula-aces-esp-ring-outer-planet-probe-2-0/>) Other companies will soon have online upper stages that could serve as platforms for outer planet missions. You would think refueling them on orbit might make possible ice giant orbit insertion with the entire

upper stage plus my proposed ESPA ring and science instrument payload  
(<https://yellowdragonblog.com/2017/11/01/ula-aces-as-planetary-probe/>)

***NASA Response: Only the launch vehicle services described in the ELV Launch Services Information Summary document are offered by NASA. Any other services not described in that document are not offered and are considered part of the PI-Managed Mission Cost.***

## **Launch Readiness Dates**

The Draft AO states, “Proposals shall propose a preferred launch readiness date during at least one of two periods: 1) July 1, 2025, through December 31, 2026 and/or 2) July 1, 2028, through December 31, 2029. The impact of switching to the non-preferred date shall be discussed in Appendix J.15. The discussion should include cost, schedule, launch vehicle, and any other significant benefits or detriments.” For the purposes of assessing impacts of using the later of the two launch dates, what should the proposer assume for NASA’s funding and programmatic milestones? For instance, should confirmation review be assumed to be delayed by three years, should an extended bridge phase or phase B be assumed, or should a longer Phase C and D be assumed?

Please provide direction regarding how a nominal project plan for the earlier LRD should – or should not – be adapted for the later LRD (ref. Requirement 102). For example, would NASA initiate low-level development upon selection at the end of Phase A, or suspend the project, deferring Phase B forward three years?

***NASA Response: The impact of switching to the non-preferred LRD discussed in Appendix J.15 is narrative in nature and requested for programmatic considerations. It will not be evaluated, and proposers are encouraged to make assumptions that minimize the impact should NASA elect to use the non-preferred LRD. Additional text will be added to the final AO.***

The AO requires that we develop a plan for both launch periods. For the second launch period, when will sufficient funding be available to start phase B?

***NASA Response: The AO does not require a plan for both launch periods. It requires a plan for the preferred launch readiness date and per Requirement 75 a brief narrative describing the impact of switching to the non-preferred launch readiness date.***

## **Proposal Structure and AO Language**

In Section 5.6.1 PI-Managed Mission Cost and Total Mission Cost, the text says that the “Phase A-D portion of the PI-Managed Mission Cost, excluding the cost of launch vehicles (Section 5.9.2), is capped at the AO Cost Cap of \$500 FY2019 dollars, or an Adjusted AO Cost Cap as applicable.” The text should say \$500M rather than just \$500.

***NASA Response: The text of the final AO will be adjusted to reflect the intent of an AO Cost Cap of \$500M, not \$500.***

Please clarify five vs. two extra pages for the Enhancing TDO. Proposal Structure and Page Limits table in Appendix B states that five pages are allocated in D/E for the Enhancing TDO. However, Requirement B-4 states that two extra pages are allotted for all Enhancing TDOs combined in Section E, and the total

number of such extra pages in Sections D-G shall not exceed a maximum of 16 + 2 (for Enhancing TDOs) extra pages regardless of the number of science instruments and flight elements.

Appendix B, Requirement B-4, is inconsistent with the table and the double asterisk right above it on the number of extra pages allocated for TDOs. Requirement B-4 says only two pages are allocated for TDOs, where the table and asterisk say 5 pages.

***NASA Response: Thank you for pointing out this discrepancy. The final AO will be adjusted to provide up to 5 additional pages for Enhancing TDO(s).***

Page B-30 (Section B, J.15) says “This appendix provides information on the non-preferred LRD (Requirement 97).” Should the cited requirement be 102 instead of 97?

Appendix J.15 refers to Requirement 97. It should refer to requirement 102.

***NASA Response: Thank you for pointing out this discrepancy. The correct reference is Requirement 102 in the draft AO, and the final AO will be corrected.***

Will the NSPIRES infrastructure be modernized to accept proposals larger than 25 MB in time for the Step 1 submittal? (Comment MISC02)

***NASA Response: NSPIRES infrastructure does not limit file sizes to 25 MB. File sizes are limited by Requirement B-5 in order to reduce the time taken for file upload by proposers and file download by reviewers. The text of Requirement B-5 in the final AO will be adjusted to 50 MB, but proposers are encouraged to keep file sizes as low as possible.***

Where should GFE be shown in Tables B3?

***NASA Response: The Discovery 2019 AO will abide by the clarification provided to the Discovery 2014 AO, which was: Each contributed GFE (e.g., flight spares) should be shown in Tables B3a and B3b as a separate contribution, below the PI-Managed Mission Cost but part of the Total Mission Cost. GFE specifically identified in the AO (e.g., launch services, UHF relay, or NASA developed technology hardware) should not be identified in Tables B3a and B3b.***

The word “additional” was added before the term “science instrument” in Requirement B-4. Does a mission with three instruments get 4 or 6 extra pages (2 for each of three instruments, or 2 for each additional instrument over the first?)?

The 2014 Discovery AO allocated 2 pages for each instrument and flight element. The 2019 draft AO has changed this to each additional instrument and flight element, effectively reducing the page count by 4. Experience from 2014 has shown that Discovery missions and instruments required the additional pages to fully address the AO requirements.

***NASA Response: The Discovery 2019 AO remains the same as the Discovery 2014 and New Frontiers 4 AOs in this regard. Each unique instrument generates an additional two pages in Sections D and E beyond the base limit of 30 pages, and each unique flight element generates an additional two pages in Section F beyond the base limit of 35 pages. Therefore, a mission with three instruments would receive an additional six pages for 36 pages total in Sections D and E, assuming the three instruments are non-identical.***

## Communications

Requirement 44 states “proposals shall address conformance to the applicable maximum channel bandwidth limit(s).” Please confirm that the applicable maximum channel bandwidth limit(s) are as stated in SFCG Recommendation 23-1. Please also confirm that demonstrating conformance with SFCG Recommendation 23-1 for X-band science data downlink meets this requirement.

***NASA Response: There are different rules for different space research service (SRS) bands. SFCG Rec. 23-1 limits the X-band (8400-8450 MHz) bandwidth used by deep space missions. The limit depends on type of mission (Mars or non-Mars) and the mission’s data rate. So, each deep space mission should comply with this recommendation and be able to show that it complies. For SRS X-band near-Earth (8450-8500 MHz) the SFCG Rec. 5-1 limits the bandwidth to 10 MHz. For the SRS S-band (2200-2290 MHz) missions the NTIA bandwidth limit is 6 MHz. There is also a SFCG Rec. 27-1 bandwidth limit of 60 MHz on the deep space Ka-band (31.8-32.3 GHz). All NASA missions are required to comply with NTIA and SFCG recommendations. If Bill give us the telecom and orbital requirements of the specific mission he is concerned about, we can tell him if that mission complies with different spectrum rules.***

If a mission can meet its science goals with X-band, is it acceptable to not include Ka-band?

***NASA Response: Requirement 43 in the draft AO in Section 5.2.5 states “Proposals shall baseline the use of Ka-band for science data return, unless it is inappropriate for the proposed investigation; proposal of an alternative communications approach shall be justified.”***

## Technology Demonstration Option(s)

Can a concept include more than one Technology Demonstration Option? Does the \$20M cost cap apply to the sum of all TDOs, or to each?

***NASA Response: Section 5.1.7 of the final AO will be adjusted to reflect that more than one Enhancing TDO may be proposed but that the total cost to NASA of all TDO activities is limited to \$20M max.***

Section 4.3.3 says the TDOs are deferred to Step 2, which is inconsistent with the rest of the proposal?

***NASA Response: The text of the final AO will be modified to show that Technology Demonstration Opportunities have been deferred to Step 2.***

## Miscellaneous

Requirements 2 and 111 state three identical CD-ROMs shall be submitted. Can DVDs be used?

***NASA Response: CD-ROMs are preferred to ensure compatibility with both CD-ROM drives and DVD drives.***

Can lab work be funded by a mission if the results are needed to interpret the spacecraft results? Certainly lab calibrations are appropriate, but lab work for interpretations might be regarded as out-of-scope.

***NASA Response: Absolutely. Mission investigations should fund any work that is needed to successfully accomplish the science objectives of the mission. This includes but is not limited to calibration and generation of other reference data sets (such as spectral libraries) needed to utilize instrument data to address the science objectives.***

Under Requirement 30 the wording “five to ten years after selection” is confusing, particularly for planetary missions with lengthy transit times. Did you mean “after launch” or “at the time of data collection”?

***NASA Response: For the Discovery Program, the necessary data validation efforts are the responsibility of the PI-led investigation. Therefore, the text of the final AO will be reworded to eliminate the language regarding data validation not directly funded by the selected PI-led investigation (including a time frame).***

Section 5.3.5, page 35, first paragraph: Add "(PS)" after Project Scientist. "PS" is used later without defining it here

***NASA Response: The final AO will be edited to incorporate this.***

Section 5.1.2 and Requirement 13 of the Discovery Draft AO stipulate that mission proposals must address the traceability between mission science objectives and the 2011 Planetary Science Decadal Survey. I agree that this requirement is appropriate as written. As you know, it is also common for missions to include traceability to the “Exploration Roadmaps” or “Goals, Objectives, and Investigations” of the relevant Assessment or Analysis Group (MEPAG, OPAG, etc.), because these documents are more specific to a given planetary body. At this point in time, some of these AGs are working on revisions of their Roadmaps or GOIs in preparation for next year’s start of the new decadal survey. However, it is unrealistic for mission teams that are now trying to finalize proposals to adapt their traceability to these evolving Roadmaps/GOIs. Accordingly, I suggest that NASA stipulate that for the purpose of this Discovery cycle, the version of record of any AG’s Roadmap/GOI will be that which existed on January 1, 2019.

Will the AO science trace to relevant and important community documentation that has been generated through forums like the AGs (and provides more specifics than the Decadal Survey)? For example, SBAG, LEAG and other AGs Goals documents, NASA Science Plan, SAT and Workshop reports (endorsed by NASA as AG special topic forums).

***NASA Response: Copies of the most recent version of roadmaps or other strategic documents produced by assessment groups will be posted in the Program Library. However, there is no requirement in the AO for proposers to address relevance to such documents, and the documents are not explicitly referenced in the evaluation criteria. The Decadal Survey and NASA 2014 Science Plan are the only documents describing science priorities that are referenced in the AO.***

Are orbital missions that perform aerobraking responsible for meeting Requirement 24 as part of the "or" in the requirement?

***NASA Response: Missions that perform aerobraking are required to include an Engineering Science Investigation. The text in Section 5.1.8 and Requirement 24 in the final AO will be modified to make this clear.***

## **AMMOS**

Section 5.2.9, page 33-34: This preference for AMMOS appears to provide a competitive advantage to JPL. Since it is their software, they will be familiar with it, and their systems will be designed for it. Reword this section to not indicate that NASA has a preference for any particular implementation of these PI missions?

***NASA Response: AMMOS is not JPL software but rather NASA software. NASA provides the AMMOS suite of tools as well as services for tool familiarization and setup free of charge. In addition, NASA does not require proposers to use AMMOS tools. NASA does require proposers to demonstrate that their preferred tool is able to accomplish its tasks. It is not clear this arrangement constitutes a competitive advantage.***

## **Cost and Budget**

How should changing exchange rates be handled in estimating the value of foreign contributions?

***NASA Response: The exchange rate to use is the official rate on the date of AO release.***

Will scan platforms, booms, etc. needed for a science payload count towards the PI-Managed Mission Cost?

***NASA Response: Yes, scan platforms, booms, etc., needed for a science payload are included in the PI-Managed Mission Cost.***

The AO says on page 2, last bullet at the top, that FY19\$ only are required for step 1. However, requirement B-52 mentions RY\$. Requirement B-53 should only ask for the FY19\$ table, B3b, and delete the requirement for table B3a, and Requirement B-54 should be deleted (or reworded) based on the use of FY19\$ only.

***NASA Response: The AO does not require a detailed WBS breakdown in both FY19\$ and RY\$. Instead, only the total funding profile for the PI-Managed Mission Cost is requested in RY\$ for NASA planning purposes. The text on page 2 of the final AO will be modified to clarify this.***

Section 5.6.3, page 41: Under Requirement 74: "approach to maintaining required unencumbered cost reserves through subsequent development phases." Change "required" to "adequate," since no required level of reserve post-Phase D is defined.

***NASA Response: The text of this requirement is being misinterpreted as requiring a specific percentage of unencumbered reserves for subsequent development phases (i.e., Phases E and F). The text is appropriately interpreted as simply requiring reserves of an unspecified amount that are unencumbered during this time period. Note that the requirement does clearly mandate a minimum of 25% unencumbered reserves against the cost to complete Phases A/B/C/D.***

The change to Phase E funding includes mention that ground and flight system software and test-bed costs must now be included under the cost cap. If the mission has a developed flight system that may be affected in a manner potentially requiring modification as the science encounter phase progresses, is the margin necessary to support that to be carried in the separate Phase E or under the \$500M cost cap?

***NASA Response: Section 5.6.1 PI-Managed Mission Cost and Total Mission Cost states “Development of ground or flight system software and the development, fabrication, or refurbishment of test-beds, which may occur during Phase E, must be considered deferred Phase D work and included under the AO Cost Cap or Adjusted AO Cost Cap.” Reserves for this type of development should be accounted for just as for other Phase D efforts. If the proposal team anticipates that ongoing modification will be necessary for such software and test beds because of inflight changes to flight hardware then those modifications should be treated as development costs and treated in the same way.***

Delete the Phase B Bridge phase funding from the bottom of the B3b template. The bridge phase funding is developed in phase A.

***NASA Response: This budget line will be removed from the text of the final AO.***

Inflation B4 table title looks wrong.

***NASA Response: The title is correct.***

Suggest modifying how costs are allocated for collaborators. Per 5.4.3, collaborators are not to be funded from the Discovery program. I understand why the funding source for collaborators is required to be submitted. I do not see or agree with including those costs in the total mission cap. Since they are not as critical as Co-I's, if their funding falls away they can either not support the mission or other sources of funding for them will be identified per the constraint. Allocating their labor to the mission seems inconsistent and an unnecessary burden.

***NASA Response: The question incorrectly states that the Total Mission Cost is capped and that Collaborator labor is allocated to the mission. The Total Mission Cost is defined as the PI-Managed Mission Cost plus any Student Collaboration costs up to the associated incentive (see Section 5.5.3) and additional costs that are contributed or provided in any way other than through the Discovery Program (such as costs for Collaborators). This does not represent an allocation of Collaborator labor to the mission. In addition, Section 4.3.2 Total Mission Cost in the AO does not provide a cap for the Total Mission Cost.***

## **Contributions**

Requirement 84 states “foreign contributions to science instruments should not exceed approximately one-third of the science payload.”

- 1) Please confirm the algorithm for calculating compliance:
  - i) Numerator = the sum of the values of foreign contributions to WBS 04 and WBS 05 of the NASA Standard WBS.

- ii) Denominator (defined as “science payload” in the requirement) = the sum of foreign contributions and domestic, PI-managed scope in WBS 04 and WBS 05 of the NASA Standard WBS.
- 2) Please quantify ‘approximately’.
- 3) The Discovery 2014 AO Q&A addressed several questions regarding the requirement for foreign contributions as well as others. Which of those written Answers apply to this Draft AO?”

When calculating the fraction of the science payload in a foreign contribution, is the foreign contribution included in the total? i.e. is it Foreign/Domestic OR Foreign/(Domestic+Foreign)?

***NASA Response: Contributions are a programmatic consideration discussed at selection rather than an evaluation factor. As such, rather than define prescriptive and explicit equations for compliance, it is NASA’s intent to provide proposers the opportunity to make a case that their contribution strategy is consistent with NASA’s “one third” policy, specifically that NASA maintains a preponderance of interest in the mission as well as ensuring that missions of roughly comparable scope are proposed for purposes of equitable competition.***

***Proposers should not assume that Q&A responses from other AOs (including Discovery 2014) are applicable to this AO. Some questions from the Discovery 2014 AO are repeated in this document and are therefore applicable to the Discovery 2019 AO.***

Does the 1/3 limit on foreign-contributed instruments apply only to Phase A-D costs?

***NASA Response: No, it applies to all phases, Phases A-D, E, and F.***

Does the 1/3 limit on foreign-contributed instruments include the contributed cost of foreign science Co-Is associated with the contributions?

***NASA Response: Yes, it includes the contributed cost of foreign science Co-Is.***

Does the 1/3 limit on foreign-contributed instruments include reserves?

***NASA Response: Neither reserves held by the foreign partner, nor any reserves held by the project (e.g., the replacement cost of a contribution which failed to appear) should be included in the 1/3 limit.***

Do foreign contributed instruments have to comply with EVM requirements?

***NASA Response: The AO does not require foreign contributed instruments to provide EVM data, but the PI is strongly encouraged to implement an adequate system to enable the penetrating and timely oversight called for in the AO.***

Should foreign contribution costs be included in the Adjusted AO Cost Cap?

***NASA Response: The Adjusted AO Cost Cap reflects a limit on the PI-Managed Mission Cost. Contributions are not part of the PI-Managed Mission Cost.***

## **Planetary Protection**

Near the bottom of page 1, the draft says the planetary protection plan is deferred to Step 2. However, there is no mention of deferring anything in section 5.1.5 or the requirements for appendix J.6. Please clarify as to what, if anything, is being deferred?

***NASA Response: Only a draft rather than final planetary protection plan is required in the Step 1 proposal. The text in Sections 5.1.5 and J.6 of the final AO will be modified to include the word “draft” to ensure this is clear.***

Section 5.1.5 references "NPD 8020.7G, Biological Contamination Control for Outbound and Inbound Planetary Spacecraft; NID 8020.109, Planetary Protection Provisions for Robotic Extraterrestrial Missions," neither of which is current. As I understand it, both of them are unlikely to be current when this AO is published, unless the Administrator extends the existing NPD and, as is possible, SMD also extends NPR 8020.12D. I know that Lisa is trying to work out the applicable documents for the AO. Meanwhile, if the NID is to be cited, then the version to be employed is the one in Requirements 20 and 21 (NID 8020.109A), so the "A" should be added to the citation noted for Section 5.1.5, in the first paragraph, as quoted above. The same correction is needed in the Section 5.2.4.2 "Restricted Sample Return" which cites "NID 8020.109" without the "A," three times. And there is the section "NASA and Federal Documents" on page D-1 that needs to be consistent, as well.

***NASA Response: The document references will be updated in the text of the final AO and in the Program Library.***

## **Requirements**

Requirement B-6, page B-4: "CD-ROMSs of proposals may additionally include up to 100 MB, higher resolution but otherwise identical, versions of electronic proposals." To eliminate confusion, I suggest this gets reworded to: "CD-ROMSs of proposals may additionally include up to 100 MB versions of electronic proposals, with higher resolution but otherwise identical content.

***NASA Response: Thank you for your comment. It will be forwarded for consideration when the standard AO is updated.***

Schedule-based end-to-end Data Management and Archiving Plan is on the deferred list, yet requirement B-24 seem to require these - what has been "deferred"?

***NASA Response: While a Data Management and Archiving Plan is still required, the language dictating that it be “schedule-based end-to-end” was removed. It was hoped this would result in a more generic Data Management and Archiving Plan that would require less effort to create.***

Requirements 35 and 38 are almost identical; one of them should be deleted.

***NASA Response: You are correct. Requirement 35 from the draft AO will be removed and the requirements renumbered as needed.***

At the end of the Appendix B requirements for the MEL, it says "Certain items should include additional details, sufficient to assess functionality and/or cost, to identify and separate individual elements." Please provide a better explanation of which types of items you have in mind.

***NASA Response: This is dependent upon the specific mission proposed and is left to the proposer for elucidation.***

The requirements in appendix B are supposed to elaborate on the requirements in the main body of the AO. Recently, the appendix B requirements have changed while the main body ones have not, resulting in an increase in the amount of information required without an increase in the page count. In order to be consistent with the changes in requirement B-44, please change Requirement 31 from:

Requirement 31. Proposals shall describe the investigation's proposed management approach, including the management organization and *decision-making process*, the teaming arrangement, the responsibilities of the PI and other team members, and the risk management and risk mitigation plans (see Appendix B, Section G, for additional detail).

To:

Requirement 31. Proposals shall describe the investigation's proposed management approach, including the management organization and *decision-making authority*, the teaming arrangement, the responsibilities of the PI and other team members, and the risk management and risk mitigation plans (see Appendix B, Section G, for additional detail).

Also change Requirement 32 to be consistent with requirement B-38, from:

Requirement 32. Proposals shall describe the investigation's proposed systems engineering approach, including plans, tools, and processes for requirements, interfaces, and configuration management. (See Appendix B, Section F, for additional detail).

To:

Requirement 32. Proposals shall describe the investigation's proposed systems engineering approach, including interface management, mission assurance approach, trade studies, identification of the key Technical Performance Measures (TPMs), and the acquisition approach. (See Appendix B, Section F, for additional detail).

***NASA Response: The intent of Requirement 31 is to gain understanding of the decision making process, not to simply understand who has the authority to make those decisions. Requirement 32 in the draft AO will be adjusted in the final AO to better parallel Requirement B-38 from the draft AO.***

## **Technology**

In some past AO's, NASA included the In Space Propulsion Technology (ISPT) Program Advanced Material Bipropellant Rocket (AMBR) engine as an incentivized technology for potential inclusion in Discovery missions. This draft AO does not include the AMBR engine in the list of incentivized technologies. Is NASA still interested in including the AMBR engine technology demonstration in the Discovery program by incentivizing it, or does NASA now consider the AMBR at TRL 6, and hence no longer in need of such incentivization? If so, does that mean that TMCO will be instructed to assume it is a TRL 6 technology?

***NASA Response: Optional mission-enabling technologies are listed in Table 4 of the AO. The Advanced Material Bipropellant Rocket is not listed as one of those technologies and no incentives (either financial, GFE, or risk assessment-related) are offered for technologies not listed in Table 4.***

## **PDS**

Historically speaking, not all Planetary Data System (PDS) nodes permanently archive raw data (the term "raw data" being assumed to encompass either or both raw frames/packets and "Level 0" data). Does this statement in the Draft AO (the second paragraph of section 4.4.3, which says: "Archival data products will include low-level (raw) data, high-level (processed) data, and derived data products...") imply that these data should now be archived within PDS nodes as well as locally within mission operations facilities?

***NASA Response: It has always been NASA's expectation that raw data is archived.***