Enclosure

1. **For the VIPER project, an updated estimate of:**

   a. **The cost and schedule to complete spacecraft development.**

      NASA Response: In addition to the $33M already requested in the FY 2025 budget submission, VIPER would need an additional $84M in total to be ready for a late 2025 launch. In the event that the VIPER mission were to be continued but for a flight later than end of 2025, substantial additional funding in FY26 and later years would be required. Estimates of this additional funding range from $235M to $611M for a landing in 2026 to 2028. Those increases would lead to total VIPER plus lander costs of $1.1 to $1.5 billion.

   b. **The cost and schedule of integration and testing (broken out separately within the development cost) for the spacecraft.**

      NASA Response: In May 2024, the VIPER project's proposed revised estimate to deliver an integrated and tested rover for a 2025 end of year lunar mission start was $145.9M.

   c. **The cost to operate the spacecraft if it was completed.**

      NASA Response: The VIPER project's proposed revised estimated cost to complete the proposed 2025 end of year lunar mission start to perform VIPER's 100-day mission operation was approximately $39.2M.

   d. **NASA's level of confidence in each of the foregoing cost and schedule estimates in a-c.**

      NASA Response: Based on delayed progress from design through rover assembly, programmatic analysis projects significant cost, schedule, and technical risk to finishing development. NASA also anticipates high-cost risk for the need to maintain an operational team to address potential additional multi-year mission start delays. For a short lunar operational period of approximately 100 days, the operations costs are foreseen as not having high-cost risks.

   e. **If the project is to be terminated, the estimated project closeout and shutdown costs.**

      NASA Response: The Agency anticipates VIPER project shutdown costs to be $33.0M.

2. **A list of all steps NASA has taken thus far to cancel VIPER, and any steps planned for the remainder of FY24.**

   NASA Response: NASA has not begun an orderly shutdown of the project as we are still evaluating responses to the RFI.

The Science Mission Directorate (SMD) conducted the formal Continuation/Termination SMD Directorate Program Management Council (DPMC), which resulted in the July 16, 2024, NASA notification that the Agency had determined to cancel the VIPER mission. NASA announced the determination on July 17, 2024, along with a call for expressions of interest from U.S. industry and international partners to launch, land, and operate the existing VIPER rover system. NASA later issued a Request for Information (RFI) to U.S. industry about potential partnerships to transport VIPER to the moon and accomplish some or all original VIPER science objectives. NASA is now reviewing the information provided and determining a path forward.

3. A copy of the NASA-Astrobotic CLPS agreement, a copy of Task Order 20A, and any documents related to contract modifications or exercised task order options.

NASA Response: The Task Order (TO) and associated materials are Controlled Unclassified Information (CUI) and will be provided under separate cover.

4. For the CLPS agreement and Task Order 20A—

a. If the VIPER spacecraft was launched as a payload on the Griffin lander—

i. A description of additional modifications to the task order or agreement that would be necessary to complete the mission, if any.

NASA Response: For Astrobotic's Griffin lander, an update to the CLPS TO will be necessary to extend the period of performance past 2024, for a launch in 2025, regardless of whether VIPER is flying on it or not. NASA may consider other modifications to the contract that focus payments on key technical risk reductions, but NASA will seek to prevent or minimize further cost growth.

Under a scenario where VIPER was maintained on TO 20A, there is a possibility that future failures or anomalies in the NASA independent assessment team's (IAT) recommended propulsion tests might mandate risk reduction changes to the TO to ensure greater reliability of the Astrobotic landing.

NASA does not have cost or schedule impact estimates for modifications to the TO for such a scenario, which would be necessary to reduce risks identified by the second NASA IAT, or improvement measures from the Griffin Failure Modes and Affects (FMEA) analyses conducted by Astrobotic as part of the Astrobotic Peregrine Mission-1 Failure Review Board. Either would be in addition to the existing TO price.

ii. An updated cost estimate and schedule for services under the task order.

NASA Response: NASA does not have a cost estimate beyond what is formally on contract for the delivery and does not intend to allow for costs to increase past $322.8M. For schedule, NASA will monitor Astrobotic's performance, as it does

with other contracts, but NASA has no schedule estimate separate from Astrobotic's schedule for a September 2025 earliest delivery.

b. A description of benefits to NASA and the Federal Government of paying the full remaining value of the CLPS 20A task order to receive data from Astrobotic for "testing" and "demonstration" of the Griffin lander, and the impact to those benefits if the test schedule for Griffin is further delayed.

NASA Response: As presently contracted, TO 20A would show that 500 kg class landers can land in the lunar polar region, which would benefit all NASA space mission directorates. NASA is also interested in the technical viability of a pulse modulated bipropellant propulsion system used on the vehicle. Completion of the TO would help to demonstrate vendor capability for future CLPS missions and, potentially, reduce risk to future CLPS awards.

5. A copy of the results and recommendations from Astrobotic's Failure Review Board for Peregrine Mission One, and a description of whether NASA accepted or agreed with such results and recommendations.

NASA Response: Enclosed is the Astrobotic publicly released a summary that included parts of the Failure Review Board (FRB) presentation. NASA leadership and staff attended the FRB outbrief by Astrobotic and agreed that Astrobotic's process was consistent with industry standards. NASA was not asked to agree or to certify results of the process.

6. A copy of NASA's FY24 reprogramming request to Congress for VIPER.

NASA Response: Just as NASA would not share communications to the Committee on Science with another Committee, NASA cannot share communications to the Committee on Appropriations. However, NASA's July 16, 2024, notification to the Committee on Science regarding NASA's proposed cancellation of the VIPER mission is substantially the same as our notification to the Committee on Appropriations.

7. An accounting of FY24 unobligated and unallocated funds for—

a. The VIPER spacecraft.

NASA Response: With regard to the accounting of FY 2024 unobligated and unallocated funds for the VIPER spacecraft, the unobligated total is $0.456M. The unallocated total is $0.736M.

b. The CLPS task order to deliver the VIPER spacecraft.

NASA Response: With regard to the accounting of FY 2024 unobligated and unallocated funds for the CLPS TO to deliver the VIPER spacecraft, the unobligated total is $0 and the unallocated total is $0.

8. **An estimated FY25 funding request, if the VIPER mission were to be continued.**

   NASA Response: The FY 2025 President's Budget Request for VIPER is $33.0M, which is now planned to be applied toward orderly closeout of the VIPER mission. If VIPER were to be continued, preliminary estimates suggest a minimum additional funding requirement of $45.0M, for a total of $78.0M, would be needed in FY2025 to continue VIPER. Additional FY2026 funding of $39M million would also be required. If VIPER were to be continued rather than cancelled, additional costs would likely be identified during testing. If the VIPER mission were to be continued but for a flight later than end of 2025, substantial additional funding in FY26 and later years would be required.

9. **A copy of records related to NASA's initiation of any non-advocate review related to the VIPER project or Astrobotic CLPS services for the VIPER project, the results of the non-advocate review, and any documentation related to NASA's assessment of the results of the non-advocate review, including records related to the VIPER Review Team in 2020 and the Astrobotic Independent Assessment Team in 2021.**

   NASA Response: This material is Controlled Unclassified Information (CUI) and will be provided under separate cover.

10. **A description of lessons learned—**

    a. **From the cancellation of Resource Prospector and how NASA has considered such lessons learned in its assessment of whether to cancel VIPER.**

       NASA Response: NASA has not identified Resource Prospector lessons learned documentation that would be applicable to the VIPER cancellation.

    b. **From VIPER that NASA will apply to future CLPS missions.**

       NASA Response: NASA intends to compile lessons learned from VIPER and the CLPS TO20A contract and will share with the Committee once complete.

11. **A detailed comparison of the estimated savings associated with terminating VIPER and flying *Griffin* with a mass demonstration payload versus completing VIPER and landing it with *Griffin*, and carrying out mission operations.**

    NASA Response: At the Continuation/Termination review for VIPER, it was projected that cancellation of the VIPER project and replacement with a mass simulator would avoid costs of at least $104.0M across both VIPER and Griffin projects assuming that a September 2025 lunar landing was achievable. Cost avoidance could be greater if other higher schedule risk scenarios for VIPER were considered, as discussed below.

    Cost avoidance could be estimated from several VIPER scenarios –

(1) September 2025 on Astrobotic's Griffin lander: Assuming the current schedules held for September 2025 delivery, it was estimated that $124.0M in additional funding would likely be needed across both VIPER and CLPS project for the Griffin lander. Specifically, VIPER would require an additional $104.0M to meet a September 2025 delivery date, which included a $20.0M increase in FY 2024 to support the workforce through the end of FY 2024. On the Astrobotic lunar lander side, NASA also foresaw a cost risk of additional risk mitigation activities for the Griffin lander that might be needed to accomplish a projected September 2025 landing, with internal estimates, based on proprietary data, of an additional $20.0M. NASA estimated that these additional funding requirements would lead to cancellation of one CLPS delivery and delay of another delivery by a year.

(2) September 2026 on Astrobotic/Griffin lander: Under a scenario where VIPER or Griffin were not able to complete lunar delivery by November 2025, and VIPER were delayed an additional year to launch for the correct lighting conditions at the Moon, NASA estimated additional costs of $50.0M associated with VIPER and additional costs of $40.0M associated with Astrobotic, beyond the $104.0M in Scenario 1 costs, for a total additional cost of $194.0M. NASA assessed that funding this within the Lunar Discovery and Exploration Program would likely lead to two additional CLPS delivery cancellations or delays.

(3) Alternative Lander Options. NASA assessed alternative delivery means for the VIPER rover outside of the Griffin lander, some of which are highly proprietary, and might have involved slipping to 2026 or later dates. Reviewing a range of highly tentative and optimistic alternative delivery approaches showed that a new lander system cost $220-350M, above the $104.0M in additional VIPER costs noted in Scenario 1, plus further continued storage costs that NASA estimated would be more than $36.0M per year. Total cost risks associated with this scenario could be $350.0-$550.0M and would still include significant uncertainty about the reliability of delivery success. Across all these impacts, NASA estimated a need to cancel four, and delay an additional three to four, CLPS deliveries.

Given this, NASA foresees significant cost avoidance by focusing on alternative methods to accomplishing VIPER's science goals.

The following table shows the projected number of CLPS TO cancellations and delays per each of these scenarios, adding up the projections shown above.

Scenario	Cancelled CLPS task orders	Delayed CLPS task orders
1: Sept 2025 on Griffin	1	1 (1 year delay)
2: 2026 on Griffin	2	2 (1 year delay)
3: Alternative Lander Options for 2027 or later	4	3 (delayed by 2 years)

12. An estimated cost and timeline to 1) disassemble, 2) store, and 3) remanifest on other missions the VIPER instruments, and an assessment of how remanifesting the VIPER

instruments on other lunar landers would affect completion of VIPER's science objectives.

NASA Response: At the time of the cancellation decision, NASA used as a rough planning estimate that maintaining VIPER rover and associated critical workforce could cost more than $3.0M per month. If only a minimal workforce was maintained, SMD assumed that $18.0M per year in total storage cost would be needed for VIPER.

Costs for storing de-integrated instruments from VIPER would likely be comparably small. Monthly storage costs for other lunar instruments that NASA has developed, such as the Neutron Spectrometer System (NSS), are on the order of $20K per month.

As VIPER project creates its shutdown plans, NASA has set targets to the project to remain within currently planned FY 2024 and FY 2025 budget marks (including the recently approved additional $20M for the FY 2024 operating plan funding profile for VIPER). This should envelope disassembly costs alongside orderly shutdown costs. NASA budgets $254M per year for CLPS and every year makes two TO selections. Actual cost and price for future CLPS deliveries always depends on technical requirements and complexity of future TO requirements as well as evolving CLPS vendor costs. The recent CS-3 delivery price to NASA was $112M whereas the original awarded price of Griffin lander was $199.5M.

Costs associated with remanifesting and using VIPER instruments on future CLPS missions could vary, ranging from little to no-cost based on adding them to currently planned instrument suites or rovers, or it could involve additional payload development costs needed to prepare the instruments for lunar operations. NASA will examine flying VIPER's instruments on Artemis crewed platforms, e.g., the Lunar Terrain Vehicle or JAXA's Pressurized Rover, both of which would be projected to have minimum development cost impacts to NASA. There are also international partner-led missions that could potentially use the instruments. For best science return, NASA would prefer to manifest the instruments on missions to explore Permanently Shadowed Regions if possible.

13. **A summary of NASA's "alternative methods to accomplish many of VIPER's goals and verify the presence of water ice at the lunar south pole", including estimated cost and schedule, and a comparison of scientific objectives completed using such alternative methods with the scientific objectives the VIPER mission planned to accomplish.**

NASA Response: While VIPER's dataset would have contributed to our knowledge of the extent and form of volatiles on the lunar surface, it does not represent the only investment in NASA's overall science strategy for addressing volatiles and resource characterization on the lunar surface. NASA is currently investing in multiple areas to derive volatile information from the lunar surface. These investments are spread across multiple CLPS deliveries, uncrewed roving assets, and Artemis crewed elements that enable volatile science campaigns focused on sample return infrastructure required to preserve the nature of the volatiles collected.

The instruments that have been developed include mass spectrometers to determine volatiles species, drills to access the subsurface, imaging spectrometers to determine volatile presence and form, neutron spectrometers to determine presence of volatiles in the subsurface, and freezers/extraction techniques employed by crew to return pristine samples from permanently shadowed regions. While all of these investments are not designed to return VIPER's exact dataset, NASA expects to gain insights over time into the majority of VIPER's original core science objectives.

South Polar CLPS missions have already begun with Intuitive Machines-1 lander in January 2024 and will continue in early 2025 with IM-2 conducting the PRIME-1 mission, a drill and mass spectrometer aimed at looking for subsurface volatiles on the Connecting Ridge between Shackleton Crater (South Pole) and de Gerlache Crater. Additional CLPS deliveries to the south polar region already on contract include the Griffin Mission-1 (NET 2025, Astrobotic), CT-3 (2025, Blue Origin), CP-22 (2027, Intuitive Machines), and CS-6 (lander to be awarded in 2025, flown in 2028). Coupled to crewed instrument deployment and sample return on crewed Artemis missions in 2026 and beyond, these missions aim to establish norms of behavior across the board with respect to operations, open science/data policies, and communication/transparency.

14. For FY24 as planned, prior to the decision proposing to cancel VIPER, for each of the next five fiscal years, provide –

a. the number of NASA civil servants, number of contractors, and number of FTEs associated with the VIPER project, including development and operations, as appropriate; and

b. the number of NASA civil servants, number of contractors, and number of FTEs associated with the Task Order 20A.

NASA Response: With regard to workforce associated with VIPER, please see breakouts below prepared for the 2025 lunar delivery revised plan forward.

	FY24	FY25	FY26	TOTAL
TOTAL WORKFORCE	**335.6**	**238.3**	**100.5**	**674.4**
Civil Service Workforce/FTE	**103.3**	**83.5**	**38.1**	**224.9**
ARC	45.0	37.7	21.1	103.8
GRC	0.5	1.3	0.9	2.6
GSFC	0.5	1.3	1.8	3.5
JSC	45.0	31.1	9.7	85.8
KSC	10.2	10.9	4.7	25.8
LaRC	0.1	-	-	0.1
MSFC	2.0	1.3	-	3.3
Contractor Workforce/WYE	**232.3**	**154.8**	**62.3**	**449.4**
APL	1.0	0.8	0.8	2.5
ARC	81.8	74.4	35.7	191.9
GSFC	1.0	0.8	0.7	2.5
JPL	1.0	1.0	1.0	3.0
JSC	140.0	68.1	19.6	227.7
KSC	6.5	9.1	4.6	20.2
MSFC	1.0	0.7	-	1.7

In addition, TO 20A is managed by an SMD CLPS Integration Manager, with total part-time effort likely less than the equivalent of two FTEs.

15. A description of NASA efforts to seek international partnerships on the VIPER mission before making the decision to cancel the program.

NASA Response: NASA did not seek international partners to land VIPER on the Moon before the cancellation decision, as NASA knew that the only robotic lander in development by an international partner that could land a payload as large as VIPER on the Moon was the European Space Agency's (ESA) Argonaut. ESA's Argonaut is in early definition and not planned to land until 2031, years later than volatiles science would be performed by other CLPS mission or Artemis human landing system missions.

After initial outreach from 11 international partners around the globe after the cancellation decision, NASA reached out to each to gauge interest in partnering with NASA on completion of the VIPER mission. Four space agencies responded, and NASA expects to enter into one-on-one discussions with the agencies to determine feasibility. The agencies/countries that have expressed interest thus far are the German Aerospace Center (DLR), the Japan Aerospace Exploration Agency (JAXA), the Israel Space Agency (ISA), and the Australian Space Agency (ASA).

16. A summary of interest expressed by U.S. entities to acquire VIPER or any of the instruments, including a description of offers has NASA received in response to its Request for Information (SMD-VIPER-01).

NASA Response: With regard to expressions of interest in future uses for VIPER, on July 17, NASA announced its intent to discontinue the VIPER mission due to overall Science Mission Directorate funding constraints, future budget risks, and lander delays. At that time, NASA requested expressions of interest from potential partners interested in conducting VIPER mission concepts that maximize value to the Agency through innovative mission ideas and arrangements. A total of 52 responses were submitted from the broad community that ranged from domestic companies and international agencies to backyard/garage enthusiasts. After analysis, 23 parties were determined to have enough spaceflight experience and technical abilities to conduct the VIPER mission.

A subsequent Request for Information (RFI) was released to domestic entities to gather more information about a VIPER partnership that would come with little to no additional cost to NASA. Responses were to include cost structure, science/other goals for the mission, teaming arrangements, technical acumen for completing the mission on the lunar surface, landing and operational plans, and adherence to open science policies for data collected with NASA instruments. NASA received 11 responses total from the community and has formed a committee to assess and validate the information provided and potential partnerships to determine best path forward. This assessment was shared with SMD senior leadership in late September. No decisions have been made on follow-on actions, and the Agency is currently evaluating next steps.

17. An assessment of the impact of cancelling VIPER to the United States' international competitiveness and leadership role in establishing any potential norms of behavior regarding operations on the surface of the Moon.

NASA Response: The United States' investments in lunar missions, including funding to advance science, are critically important to our country's competitiveness and leadership role in establishing potential norms of behavior. Through NASA's lunar science initiatives, NASA will be exploring more of the Moon than ever before.

South Polar CLPS missions began in January 2024 and will continue in early 2025. Additional CLPS deliveries to the south polar region already on contract include the Griffin Mission-1 (NET 2025, Astrobotic), CT-3 (2025, Blue Origin), CP-22 (2027, Intuitive Machines), and CS-6 (lander to be awarded in 2025, flown in 2028). Coupled with crewed instrument deployment and sample return on crewed Artemis missions in 2026 and beyond, these missions aim to perform important science objectives tied to lunar volatiles. NASA further anticipates that its activities will help establish norms of behavior for responsible exploration.