Selection Statement
For
Commercial LEO Destinations
(Announcement Number 80JSC021CLD)

On November 19, 2021, I along with other senior officials of the National Aeronautics and Space Administration (NASA), met with the Participant Evaluation Panel (PEP) appointed to evaluate proposals submitted in response to the Commercial LEO Destinations (CLD) Announcement (Announcement Number 80JSC021CLD).

I. Background and Evaluation Process

In June 2020, NASA established the Commercial Low Earth Orbit (LEO) Development Program at the Johnson Space Center as part of the Human Exploration and Operations Mission Directorate. The objectives of the Program, which is now part of the Space Operations Mission Directorate, are to (1) develop a robust commercial space economy in LEO, including supporting the development of commercially owned and operated LEO destinations from which various customers, including private entities, public institutions, NASA, and foreign governments, can purchase services; and (2) stimulate the growth of commercial activities in LEO. In order to cost-effectively meet U.S. long-term research and technology development needs in LEO, a robust commercial human spaceflight economy must be established including commercial destinations and new markets to allow various customers access to a broad portfolio of commercial products and services. Development and operation of a commercial destination to provide those services will require significant private investment over many years and significant non-NASA demand to ensure long-term financial viability.

NASA envisioned the Commercial LEO Destinations (CLD) project, since renamed Commercial Destinations-Free Flyer (CDFF), to be executed in 2 phases.

- Phase 1 is a period of formulation and design by private industry, in coordination with NASA, of CLD capabilities determined to be most suitable for potential Government and private sector needs. Participants are expected to achieve at least a Preliminary Design Review (PDR) level of maturity.
- Phase 2 is a potential competitive procurement under the Federal Acquisition Regulation of services in LEO, which would include certification by NASA of the transportation and accommodations of NASA crew and payloads on a CLD.

This Announcement solicited proposals for Phase 1 of CDFF and anticipates entering into multiple funded Space Act agreements (SAAs) agreements with private industry to support development of the vehicles, systems, and operations needed to deploy and operate free-flying LEO destinations to meet the potential future needs of various customers including the US Government.

Selected CDFF participants will receive funded SAAs under NASA's other transactions authority within the National Aeronautics and Space Act, 51 U.S.C. § 20113(e). These agreements will consist of a period of performance from award to late FY 2025.

The Announcement was released on July 12, 2021. It divided the proposals into three sections with two appendices, all due on August 26, 2021. Section I was an Executive Summary, Section II was the Business Plan, and Section III was the Technical Approach. Appendix 1 contained a proposed Space Act Agreement and Appendix 2 was to provide Supplemental Business Data. Amendment 1 was issued on July 14, 2021 to correct typos in the Announcement. Amendment 2 was issued on July 23, 2021 to revise section 4.2.3 B3.C of the Announcement and Article 27.A of the SAA. Amendment 3 was issued on

August 5, 2021 to revise proposal submittal instructions in section 4.1, clarified in section 4.2.3 that major partners shall be identified in the proposal, and to allow major partner and supplier data to be included in Appendix 2. Proposals were received from the following companies (Participants):

- Nanoracks
- Space Villages Inc.
- Northrop Grumman Systems Corporation
- Blue Origin, LLC
- Orbital Assembly Corporation
- Hamon Industries
- ThinkOrbital Inc.
- DEHAS Limited
- Maverick Space Systems Inc.
- Space Exploration Technologies Corporation (SpaceX); and
- Relativity Space Inc.

The evaluation and selection were conducted using a six-step process:

Step 1 – Acceptance Screening
Step 2 – Initial Evaluation
Step 3 – Finalist Selection
Step 4 – Due Diligence
Step 5 – Portfolio Selection
Step 6 – Finalize Space Act Agreements

Acceptance Screening: Upon proposal receipt, the Agreements Officer reviewed all proposals to determine whether each proposal was consistent with the Announcement's proposal instructions. Additionally, the voting members of the PEP read the executive summary of each proposal to determine whether the proposal satisfied the following fundamental criteria as defined in the Announcement:

1. Propose an independent, free-flying Commercial LEO Destination;
2. Demonstrate significant concept definition and design maturation; and
3. Culminate in an approximate Preliminary Design Review (PDR) level of maturity.

If after reading the Executive Summary, it was determined that the proposal failed to meet the fundamental criteria, it was considered an unacceptable proposal. Proposals that received an initial unacceptable proposal rating were eliminated from further evaluation.

Hamon Industries' proposal did not meet the fundamental criteria because the Executive Summary did not demonstrate significant concept definition and design maturation and did not identify in the Executive Summary that its proposal would reach at least a PDR level of maturity. Therefore, the proposal was considered unacceptable and eliminated from further evaluation.

DEHAS Limited's proposal did not meet the fundamental criteria because the Executive Summary did not demonstrate significant concept definition and design maturation and did not identify in the Executive Summary that its proposal would reach at least a PDR level of maturity. Therefore, the proposal was considered unacceptable and eliminated from further evaluation.

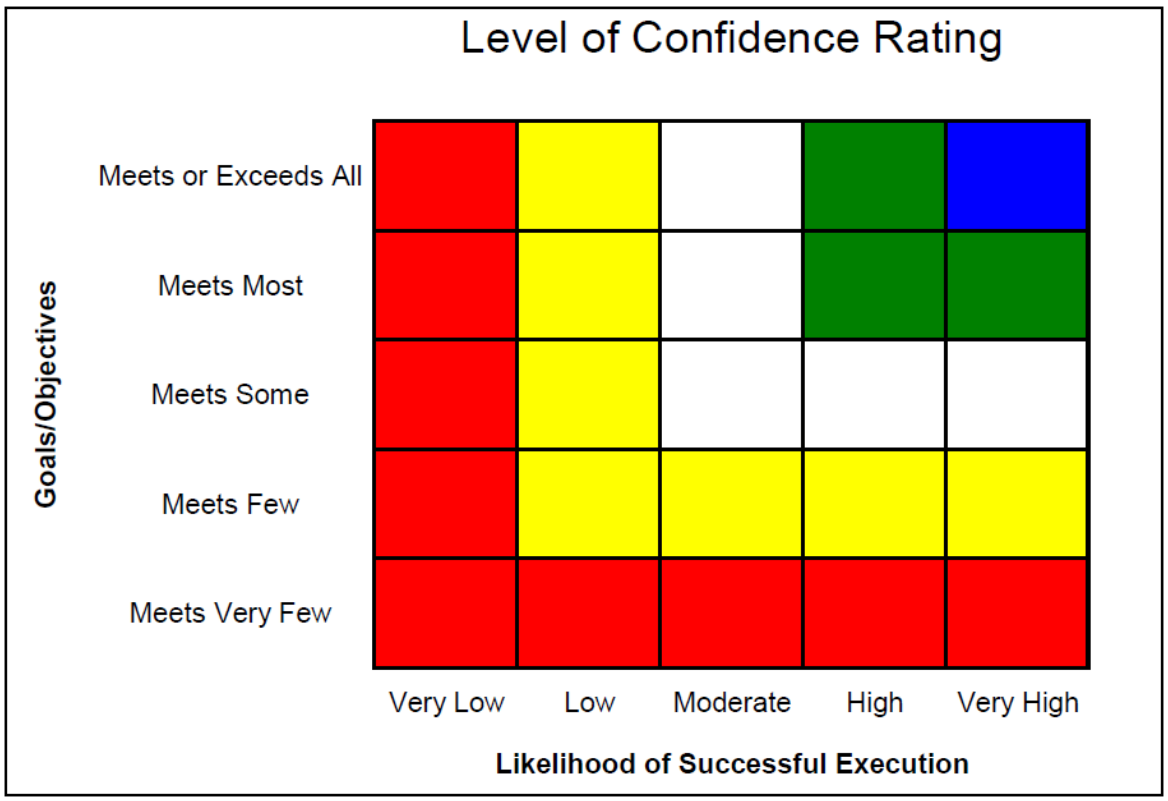
Initial Evaluation: The PEP then conducted an initial evaluation of the remaining proposals that passed the acceptability screening. Each proposal was evaluated on its Technical Approach and Business Plan

sections on a standalone basis without comparison to other proposals. Evaluators identified the distinguishing factors of each proposal as it relates to the likelihood of success and the ability of each proposal to meet the stated goals of the Announcement. These distinguishing factors were documented as findings of strengths and weaknesses. The Technical Approach and Business Plan team leads each convened a meeting of the evaluation team to review all findings in their respective areas, and prepared team findings representing their respective areas along with a recommended Level of Confidence rating for their respective areas based on the team findings. The team leads then presented the proposed team findings and rating recommendations for their respective areas to the PEP voting members. At the conclusion of the initial evaluation, the PEP voting members reached a consensus on all findings and determined initial Level of Confidence ratings for each proposal's Technical Approach and Business Plan sections.

There are five Level of Confidence ratings:

Color	Criteria
B	**Very High Level of Confidence**: The proposal section meets or exceeds nearly all of the goals or objectives described in the Announcement and there is a very high likelihood of successful execution.
G	**High Level of Confidence:** The proposal section meets most of the goals or objectives as described in the Announcement and there is a high likelihood of successful execution.
W	**Moderate Level of Confidence:** The proposal section meets some of the goals or objectives as described in the Announcement and there is a moderate likelihood of successful execution.
Y	**Low Level of Confidence:** The proposal section meets few of the goals or objectives as described in the Announcement or there is a low likelihood of successful execution.
R	**Very Low Level of Confidence:** The proposal section meets very few of the goals and objectives as described in the Announcement or there is a very low likelihood of successful execution.

The PEP used this matrix below as a guide to help determine the level of confidence ratings based on the evaluation summaries of each proposal and the goals and objectives listed in the Announcement:



Finalist Selection: After all standalone evaluations were complete, the PEP prepared a presentation to me summarizing the results of the initial evaluation and I determined the proposals most favorably evaluated as candidates for further due diligence discussions. All other proposals received no further evaluation at this point.

Due Diligence: NASA conducted teleconference due diligence meetings with participants whose proposals were most favorably evaluated. Participants were provided with a list of its initial findings and questions resulting from the initial evaluation and were given the opportunity to present their overall business plan, technical approach, and responses to questions submitted by NASA, as well as resolve issues associated with the proposed Space Act Agreements. After completion of the due diligence meetings, the PEP reconvened to modify or amend the proposal evaluation summaries based on any new information obtained that may have impacted the initial evaluation screening results and assign final Level of Confidence color ratings based on the modified or amended evaluation summaries, if any.

Portfolio Selection: The PEP presented to me and my advisors a summary of the proposal evaluations including the consensus findings, Level of Confidence ratings, proposed NASA funding amounts, and the identification of all other proposals that did not receive further evaluation. This included the PEP's analysis of different portfolio combinations for award and recommendation for selecting one or more proposals for award and the respective amount of NASA contribution to be offered.

II. Initial Evaluation

Nine proposals passed the Acceptability Screening and were evaluated by the full PEP. The Technical Approach and Business Plan sections were evaluated separately with a Level of Confidence rating given for each, based on the consensus findings prepared using the distinguishing factors (strengths or weaknesses) in the proposal.

Nanoracks
For the Technical Approach evaluation, Nanoracks received a Level of Confidence rating of **White**.

Its significant strengths included leveraging many technically mature designs, which increases likelihood of meeting schedule; and proposing a single-launch capability to reach its initial operating configuration, which significantly reduces assembly complexity and allows for integrated ground testing. Its strengths included a modular design to allow for an evolutionary path in support of exploration analog missions; proposing more than 2 crew members for initial operations; incorporating a Biological Centrifuge as a step toward the artificial gravity stretch goal; inclusion of a robotic arm; proposing a reconfigurable general purpose lab bench system; and building a Starlab ground analog lab to support payload providers.

Its significant weaknesses included its ambitious proposed launch date using a low technically mature inflatable habitat technology; and the greatly overestimated level of Environmental Control and Life Support System (ECLSS) closure proposed to be achieved at initiation and greatly underestimated projected resupply needs. Its weaknesses included the volume of the exploration analog is too large to meet the $100m^3$ stretch goal for deep space transportation conditions; lack of detail to understand CLD sparing and maintenance plan beyond use of heritage hardware; lack of a plausible ram facing payload to meet external payload goals; and lack of a high-level design overview of its Guidance, Navigation, & Control (GN&C) system.

For the Business Plan evaluation, Nanoracks received a Level of Confidence rating of **White**.

Its significant strengths included a strong business strategy to develop the LEO economy; a very thorough and convincing marketing strategy; a very significant level of private investment; and a very strong marketing plan that supports revenue estimates. Its strengths included a CEO with strong relevant experience; a schedule that exceeds NASA's PDR and initial operating capability goals; early operations involvement, which reduces risk; and having suppliers with the necessary workforce, facilities, and relevant experience.

There were no significant weaknesses identified. Its weaknesses included unclear reporting structure; its proposed Program Manager is currently under a restriction from representing back to NASA; lack of detail on its financing plan; unrealistic revenue estimates while ISS is still serving users; risk of cost increases by its prime contractor; schedule risk due to technology development; and potentially obsolete and unavailable payload facilities.

Space Villages Inc.
For the Technical Approach evaluation, Space Villages received a Level of Confidence rating of **Red**.

There were no significant strengths identified. Its strengths included a proposed modular architecture that enables evolutionary growth potential to provide flexible customer services and a dedicated CLD maintenance crew that enables timely repair and maintenance of CLD facilities.

Its significant weaknesses included a lack of detailed information about life support and crew safety regarding the use of its crew orbital transfer system; a lack of technical detail and demonstrated understanding on its concept for its complex/low technical maturity CLD platform; an unrealistic approach and inadequate assessment of resupply needs for proposed CLD operations; a lack of information about proposed research facilities' capabilities to accommodate payloads; and lack of information about systems development and associated risks; a lack of a development plan for the novel Rendezvous Service Vehicle; a weak technical risk assessment, which reduced confidence in its risk management strategy; a weak system engineering and integration strategy; a lack of a comprehensive test and verification strategy; a lack of information on its proposed assembly sequence to determine the feasibility of plans; a lack of significant details of concept and associated risks about its proposed crew evacuation and rescue plans to understand the suitability or feasibility of its concept; and a lack of information about crew accommodations to evaluate feasibility and safety. Its weaknesses included its artificial gravity concept carried high technical risk to the main space platform by inducing unbalanced loads and structural forces; a lack of detailed explanation on its proposed exploration analog services; and the use of toxic ammonia as an external cooling fluid, which increased the risk to crew safety.

For the Business Plan evaluation, Space Villages received a Level of Confidence rating of **Yellow**.

There were no significant strengths identified. Its strengths included a broad marketing strategy and a very detailed and sophisticated cost estimate.

Its significant weaknesses included a lack of relevant technical and business management experience and a lack of any secured major suppliers. Its weaknesses included a lack of a solid financing plan; simplistic risk mitigation; and schedule risk created by the need to acquire funds before acquiring development resources.

Northrop Grumman Systems Corporation (NG Space)

For the Technical Approach evaluation, NG Space received a Level of Confidence rating of **Green**.

Its significant strengths included the use of modules and systems with high technical maturity, increasing the likelihood of meeting its proposed development schedule. Its strengths included increased access at initial operating capability due to the capability to support 4 crew; a modular architecture that enables growth potential for future demand; a system design that optimizes maintainability; a comprehensive description of ground operations that increases confidence in mission success; the inclusion of a robotic arm, which increases external utilization and reduces the need for EVAs for maintenance; a comprehensive training plan and ground support for on-orbit crew and flight control team; a comprehensive risk management process and detailed technical risks; and a planned demonstration of docking capability prior to the first crewed mission, which enables risk reduction for docking operations.

Its significant weaknesses included a lack of design description and apparent volume available to accommodate larger payload facilities within the proposed CLD modules. Its weaknesses included underestimated crew services resupply estimates for its proposed CLD configuration; insufficient power available to meet its proposed ECLSS needs; and proposing a design using small hatches that may not be able to accommodate larger payloads.

For the Business Plan evaluation, NG Space received a Level of Confidence rating of **Yellow**.

Its significant strengths included the use of existing flight hardware, which increased the likelihood of meeting its proposed CLD schedule. Its strengths included an experienced management team; in-place development resources; and the proposed use of experienced major suppliers.

Its significant weaknesses included a weak marketing strategy and lack of experienced business development personnel; proposing very low private investment; an unsubstantiated financing plan; and no schedule provided past PDR. Its weaknesses included minimal ability to accommodate non-NASA customer payloads at initial operating capability; and unaddressed risk of Habitation and Logistics Outpost (HALO) dependency.

Blue Origin, LLC

For the Technical Approach evaluation, Blue Origin received a Level of Confidence rating of **White**.

Its significant strengths included robust proposed research capabilities to support NASA and customer research goals and flight demonstration of subscale modules Its strengths included a 6 person crew operations concept, which provides greater access at initial operations; an architecture that enables inclusion of an isolated exploration test bed; designing systems with maintainability in mind, which increased the likelihood of sustainable CLD operations; large volume and redundancy across critical systems, which provides fault tolerance and flexibility to meet customer goals; the use of a Common Berthing Mechanism (CBM) interface, which provides a large hatch for increased accommodation of larger payloads and crew; the inclusion of a robotic arm for external operations, which increases maintenance flexibility; the use of proven Amazon logistics approach, which increases likelihood of successful ground hardware management supporting crew and payload services; a comprehensive crew training proposal; an on-orbit maintenance crew; its overall risk management process that leverages human spaceflight lessons learned; early prototyping and mock-up included in its design; strong external thermal control design and risk assessment; a strong emergency response plan; and a docking demonstration prior to baseline, which builds confidence in docking.

Its significant weaknesses included low technically mature elements including inflatable modules and single person spacecraft, which are significant risks to meeting the proposed schedule; proposing a regenerative closed loop ECLSS, which is a scale up of existing ISS systems and carries significant schedule risk; and complex integration between its partners and complex launch and assembly. Its weaknesses included zenith facing external payloads are obstructed; proposed 3-D printing of spares in microgravity; and use of legacy GN&C hardware, which carries obsolescence risks.

For the Business Plan evaluation, Blue Origin received a Level of Confidence rating of **White**.

Its significant strengths included an ambitious business strategy and strong, relevant experience of Blue Origin and its partners and suppliers. Its strengths included a strong marketing plan; a significant level of private investment for the base period; a proposed schedule that exceeds NASA's PDR and Initial Operating Capability (IOC) goals; and use of existing development resources.

Its significant weaknesses included seeking more funds than NASA stated is available. Its weaknesses included failing to propose business milestones with meaningful success criteria; unclear roles of its partners in raising financing; unrealistic early revenue estimates while ISS still serves users; no plan to manage supplier cost overruns; and schedule risk due to technology development.

Orbital Assembly Corporation (OAC)

For the Technical Approach evaluation, OAC received a Level of Confidence rating of **Red**.

Its significant strengths included a flight demonstration of automated on-orbit assembly of truss. Its strengths included more than 2 crew members at initial operations; modularity to increase flexibility and

growth potential for the CLD; a design that provides capacity for large payloads; an artificial gravity proposal that includes external payloads, which could benefit future technology development; a maintenance crew for the CLD; and strong emergency response and redundancy planning.

Its significant weaknesses included a lack of understanding of complexities for resupply for the artificial gravity concept and large crew proposed; not addressing space environment challenges with maintaining a CLD in continuous sun synchronous orbit; a lack of availability of launch facilities to launch crew into a sun synchronous polar orbit; use of NASA heritage hardware without a declaration of its GFE needs and claims that its modified ISS ECLS system will have larger capacity than currently realized; its proposed long-duration artificial gravity concept for CLD is incompatible with some research; limited CLD development description; a weak risk strategy; and a complex assembly proposal. Its weaknesses included a lack of controllability assessment for its artificial gravity design and an unidentified avionics and Command and Data Handling (C&DH) design and risk assessment.

For the Business Plan evaluation, OAC received a Level of Confidence rating of **Red**.

There were no significant strengths and no strengths identified.

Its significant weaknesses included failure to provide a customer-based business strategy; a proposed management team that has no experience in funding and developing a large-scale human space system; seeking more funds from NASA than its costs during the SAA; seeking massive financing without presenting a viable financing plan; seeking massive revenue without presenting a viable marketing plan; proposing its Critical Design Review (CDR) occur before its PDR; and failure to meet requirements of the Announcement regarding major suppliers. Its weaknesses included lack of a clear plan for an early demonstration mission and schedule risk due to the need to acquire funds before acquiring development resources.

ThinkOrbital Inc.

For the Technical Approach evaluation, ThinkOrbital received a Level of Confidence rating of **Red**.

There are no significant strengths identified. Its strengths included more than 2 crew members at initial operations and a large internal volume that lends itself to flexibility in design to support multiple customers.

Its significant weaknesses included an inadequate and incomplete risk strategy; lack of detail on its concept for an incredibly complex on-orbit outfitting of systems internal and external to its CLD.; a complex on-orbit construction of its CLD using nascent electron beam welding; the use of a large, unassessed gas supply needed for initial pressurization of its habitation module; its proposal to install common external systems inside the crew cabin, raising safety concerns. Its weaknesses included the lack of definition of its artificial gravity capability; the limited proposed positioning and pointing of external payload platform; the lack of detail on how the exploration analog goals could be met given only a single habitation module; its proposed use of payload hardware that is no longer in production or commercially available without addressing how hardware obsolescence will be mitigated; proposed on-orbit construction and outfitting of CLD is limited by small hatch size and increased complexity for piece part assembly; inaccurate understanding of what is needed to mature an ECLS system; an undefined platform mass and system architecture for its proposed single-launch capability; safety concerns about its future plan to increase crew size without a crew evacuation plan; and a lack of safety & mission assurance involvement in design.

For the Business Plan evaluation, ThinkOrbital received a Level of Confidence rating of **Red**.

There were no significant strengths identified. Its strengths included several spaceflight experienced suppliers were identified for CLD development.

Its significant weaknesses included a poor market strategy that failed to meet LEO economy development goal; a significant lack of relevant space experience by the management team; proposing very low private financing in the base period and none in the option period; lack of a viable financing plan; risk of revenue needed to fund development not materializing; a CDR plan that only involved building a prototype; insufficient detail provided on the overall development schedule; and a failure to conform to the 50% ownership by U.S. nationals requirement. Its weaknesses included no commitments from several key suppliers and no proposed supplier cost estimates.

Maverick Space Systems Inc. (Maverick)

For the Technical Approach evaluation, Maverick received a Level of Confidence rating of **Red**.

There were no significant strengths identified. Its strengths included a beneficial radiation shielding concept using supply water; a modular design concept that allows for growth; inclusion of an internal and external robotic arm, which would greatly increase remote operations and maintenance capabilities; an iterative development approach that reduces technical risks; and a prototype testing plan for key components prior to PDR.

Its significant weaknesses included a design focused on robotic/telescience LEO research rather than human presence; significant freeze/rupture risks created by use of water in the external thermal control system; lack of internal payload accommodations for NASA research; and proposed use of low maturity technologies for critical systems. Its weaknesses included weak micro-meteoroid and orbital debris shielding strategy; added complexity from a proposed redesign of the NASA Docking System; insufficient data provided for proposed artificial gravity concept; a lack of detail on its external payload mounting site; a lack of permanent crew accommodations for long duration presence; a single docking port, which decreases resupply and crew handover capabilities; a small hatch diameter, which reduces cargo transfer capability; an insufficient timeline for proposed regenerative ECLS development; complications with all-water working fluid; a lack of detail on its water resupply strategy; low design maturity on its water jet Reaction Control System; and no inclusion of an on-orbit safety plan in its proposed CLD plan.

For the Business Plan evaluation, Maverick received a Level of Confidence rating of **Red**.

There were no significant strengths identified. Its strengths included a business plan optimized for several market niches and a compelling case for a modular approach for its small module concept in LEO.

Its significant weaknesses included a management team that all comes from the small satellite industry; seeking the vast majority of its SAA costs from NASA; and a failure to identify who will supply many of the systems required for the proposed CLD. Its weaknesses included unrealistic revenue estimates while ISS is still serving users; the proposed total cost through CDR seems unrealistically low; schedule was included in the wrong proposal section and, therefore, not evaluated; and unclear start-up plan to acquire needed personnel and facilities.

Space Exploration Technologies Corporation (SpaceX)

For the Technical Approach evaluation, SpaceX received a Level of Confidence rating of **Yellow**.

Its significant strengths included proven speed, safety, and systems engineering in vehicle manufacturing; its early prototype and demonstration plan for HLS can increase technical maturity on some CLD systems; and a comprehensive and proven safety and risk management approach. Its strengths included more than 2 crew members at initial operations; a strong approach to future commercial communications including the maturity of Starlink; and a proven design and strategy for rendezvous and docking.

Its significant weaknesses included a lack of definition on its CLD concept; a lack of definition for external payload accommodations; a lack of payload capabilities definition in its proposed conversion of Human Landing System (HLS) into a CLD; and a lack of detail for scaling up ECLS from a short to long duration capability. Its weaknesses included limited available payload power for its proposed CLD and proposing a single docking part, which reduces crew and cargo access to the CLD.

For the Business Plan evaluation, SpaceX received a Level of Confidence rating of **Red**.

Its significant strengths included rapid development of Starship and a planned orbital mission in the coming year; use of in-house developmental resources; and no dependence on outside suppliers. Its strengths included strong financial resources, which increase the likelihood of successful execution in the event of cost overruns.

Its significant weaknesses included a lack of business strategy, which fails to meet goals for developing the LEO economy; seeking full reimbursement of its narrowly scoped SAA costs from NASA, despite leveraging private financing of Starship; no proposed PDR on its CLD system, which fails to meet one of the primary goals of the Announcement; and milestones do not objectively demonstrate technical or business progress. Its weaknesses included its high dependence on HLS without addressing it as a risk.

Relativity Space Inc. (Relativity)

For the Technical Approach evaluation, Relativity received a Level of Confidence rating of **White**.

Its significant strengths included a reusable and returnable lab with a return capability; proposed iterative prototyping and testing in hardware development; and its in-house development approach. Its strengths included more than 2 crew members at initial operations and frequent, short duration missions support its simple ECLS concept.

Its significant weaknesses included no plan for how systems will be matured for longer duration crewed missions which is a major risk to the goal of continuous human presence. Its weaknesses included a lack of detail in payload accommodations; a minimal strategy for crew accommodations; a weak training and mission control concept for CLD; limited payload power for its proposed CLD; a lack of mitigation strategies on CLD systems beyond additive manufacturing; and low technical maturity for additive manufacturing on the scale proposed.

For the Business Plan evaluation, Relativity received a Level of Confidence rating of **Yellow**.

There were no significant strengths identified. Its strengths included strong technical management; experience in launch vehicle development; and good in-house development resources.

Its significant weaknesses included a failure to present a business strategy; inclusion of launch vehicle development in the SAA, which is outside the scope of the Announcement; and no description of an overall CLD development plan or any schedule beyond CDR. Its weaknesses included not specifying who is in charge of the company's CLD program; proposing that NASA pay most of its costs under the SAA; and reliance on cash and revenue that is unsubstantiated.

III. Final Evaluation after Due Diligence

In accordance with the Announcement and Evaluation Plan, the most favorably evaluated proposals were selected for due diligence. Three proposals went through due diligence: Nanoracks, Northrop Grumman Systems Corporation, and Blue Origin, LLC.

While each finalist was given the opportunity to submit revised proposals, none of them chose to do so based on NASA feedback during due diligence discussions. Each finalist focused instead on updating and revising the Space Act Agreement (SAA). With each finalist, the PEP discussed agreement milestones – including additional milestone content, success criteria, and payment amounts – and adjusting milestone content between the base period and optional period. Based on feedback from me during the initial evaluation briefing, the PEP worked with finalists to add at least 2 test and demonstration milestones to each SAA and ensured that all SAAs had at least 2 business milestones.

The PEP considered these SAA revisions when it reconvened and provided their evaluation summaries, along with the revisions made to each finalist's SAA, including milestones, to me as part of its final evaluation briefing on November 19, 2021. Below is a summary of the PEP's analysis on how the SAA revisions impacted the initial evaluation findings.

Nanoracks
Nanoracks updated its SAA milestones to include six significant testing and demonstration activities during the term of the SAA, taking its activity through to Critical Design Review. Its' SAA did not resolve any of the identified weaknesses.

Northrop Grumman Systems Corporation (NG Space)
NG Space updated its SAA milestones to include two significant testing and demonstration activities during the term of the SAA, taking its activity through to Preliminary Design Review. Its' SAA did partially resolve the identified significant weakness of proposing very low private investment by increasing NG Space's contribution to the development. All other identified weaknesses remained.

Blue Origin LLC
Blue Origin updated its SAA milestones to include five significant testing and demonstration activities during the term of the SAA, taking its activity through to Critical Design Review. Its' SAA did resolve the identified significant weakness of seeking more funds than NASA stated was available by adjusting its milestone payments and resolved the identified weakness of failing to propose business milestones with meaningful success criteria by including two business milestones with meaningful success criteria.

IV. Portfolio Selection Decision

Following the presentation by the PEP, I fully considered the findings presented to me and held an executive session with my advisors to discuss the evaluation results. I asked the opinion of the advisors present and asked for their comments, objections, or concerns with the materials presented. Following this discussion, I compared the proposals against the criteria of the Announcement and considered the evaluation summary table provided by the PEP, which summarized each participant's proposed capabilities and evaluation color ratings, to select a portfolio of approaches that collectively meets the CDFF goals within the available funding, as stated in the Announcement. I explain the discriminating factors and the significance of those discriminators in my selection decision, as follows:

The objectives of the Commercial LEO Development Program are to develop a robust commercial space economy in LEO, including supporting the development of commercially owned and operated LEO destinations from which various customers, including private entities, public institutions, NASA, and foreign governments, can purchase services and to stimulate the growth of commercial activities in LEO. In accordance with the Announcement and Evaluation Plan, I compared the proposals against the criteria of the Announcement to select a portfolio of approaches that best meets the objectives of the CLD Program.

I found that the updated SAAs, including milestones, that were presented by the PEP following due diligence discussions mitigated or eliminated several of the weaknesses identified by the PEP in its initial briefing and agree with the PEP's assessment. Although this is a relatively short list of weaknesses that I considered to be resolved, it is important to point out that during my discussions with the PEP on the evaluation results, it was clear to me that many of the weaknesses described by the PEP were resolvable, should the parties have pursued proposal updates. By foregoing proposal updates, the finalists enabled me, the PEP, and the agency to successfully conclude the competitive process quickly, with no demonstrable influence on the selection decision.

Blue Origin's proposal for its Orbital Reef leverages the space flight experience of Boeing and Sierra Nevada both in architecture and in operational approaches. Orbital Reef's ambitious design provides the largest amount of habitation space and research volume of the three proposals and critical system hardware redundancy that exceed most of NASA's goals, including an initial crew capability of six and accommodating stretch goals of artificial gravity and exploration analog missions. Orbital Reef will also include facilities for a broad range of life and physical science applications that are relevant to NASA and other customers. Its proposed use of the Common Berthing Mechanism interface will enhance the ability of Orbital Reef to accommodate large payloads. Other technical strengths in the proposal included having a dedicated maintenance crew, a comprehensive crew training concept, and innovative logistics approach. Blue Origin's business plan meets most of the goals as stated in the Announcement with a moderate likelihood of successful execution. The company has an aggressive schedule that requires significant development work, so it is not clear whether it can achieve operations on the proposed timeline. However, the proposal otherwise is strong given its marketing approach and very experienced suppliers who understand human-rated space system development.

Nanoracks brings a wealth of knowledge and experience integrating payloads on ISS and they have partnered with leaders in the space industry with realized flight and hardware experience which provides confidence that Nanoracks' proposal could meet NASA's CLD goals. Nanoracks' modular design concept and the proposed ability to meet all of NASA's CLD technical goals, except for minimal GFE and stretch goals, except for adequate exploration analog crew volume, is of great benefit. Nanoracks' partnership with Lockheed Martin provides a significant knowledge base in spacecraft architecture, and the team provides a robust assessment on technical risks and mitigations throughout the proposal. However, the team's lack of experience with inflatable technologies and the proposed advanced application of the concept as a full habitation module carries some development risk. Given the amount of technology development work that will be required to realize a fully operational commercial LEO destination as proposed by Nanoracks, there is moderate confidence that the concept could be realized by the proposed launch date of 2027. Its proposal meets all the business goals in the Announcement, including non-government customers, profitable operations, significant non-NASA investment, and early operations; but with uncertainty in financing, early revenue, and adequacy of development time. Nanoracks also proposed a broad marketing strategy built on experience in flying customer payloads to ISS and owning/operating ISS commercial augmentations, which is important for encouraging development of a LEO economy, a key objective of the CLD Program.

Nanoracks and Blue Origin have proposed six testing and demonstration milestones and five testing and demonstration milestones, respectively, during the term of their SAAs, which I considered significant for addressing NASA's goal of early demonstrations of hardware, subsystems, and key technologies. I also noted that both Nanoracks and Blue Origin have updated their SAAs to propose reaching Critical Design Review during the term of this SAA – Nanoracks for both its spacecraft element as well as its ground analog element and Blue Origin for its overall Orbital Reef destination – which significantly exceeds the goal of achieving at least a Preliminary Design Review level of design maturity.

NG Space is proposing to make less progress than Nanoracks and Blue Origin by only progressing to a Preliminary Design Review level of design maturity. However, it had the highest rated technical approach of all three proposals and is lower risk than both Nanoracks and Blue Origin. NG Space demonstrated its wealth of experience with space flight both in architecture and in operational approaches. It married its experience with HALO and Cygnus to provide a proposal that met or exceeded NASA's goals with a high likelihood of successful execution. NG Space's CLD concept has limited research volume at IOC which makes it less likely that larger payloads and facilities could be accommodated. It is also unclear that in the period between Element 1 launch and Element 2 launch there will be sufficient payload capabilities available to service the needs of both NASA and commercial interests. Given NG Space's technically mature module design and spaceflight experience, there is a high likelihood that the proposed CLD could be realized on schedule. On the business side, however, NG Space's proposal met some CLD goals but the PEP gave it a low likelihood of successful execution. While it is likely to meet its schedule from use of existing elements and in-place developmental resources, it failed to provide a credible plan to attract non-Government customers or acquire significant commercial revenue in its first phase of operations. Further, while NG Space increased its level of investment as a result of due diligence, it still had a relatively low level of non-NASA investment in its SAA and there was no clear financial plan provided for after PDR. Additional business milestones were added as a result of due diligence that I believe may address these issues during SAA implementation to focus on developing and expanding the LEO economy.

Looking across all three finalist proposals, they all meet the overall project goals as stated in the Announcement for the development of safe, reliable, and cost-effective LEO destinations, the capability to accommodate crew and payloads for multiple customers, continuous human presence, reaching at least a PDR level of design maturity by the end of the term of the SAA, encouraging development of a LEO economy, providing CLD operational status as early as possible, and early demonstrations of hardware, subsystems, and key technologies. The proposal by NG Space is not as ambitious in scope as those from Blue Origin and Nanoracks, since it proposes both smaller payload volume and habitable volume than the others and only looks to reach PDR, which means its impact to stimulate the market development in LEO will likely not be as great. But it was a technically stronger and lower risk proposal than the others, which provides this portfolio with a more balanced risk spread for achieving at least one commercial LEO destination during the course of this project.

I also considered the total anticipated funding of the various proposals in determining the number of awards that best meet the goals of the Announcement. Nanoracks asked for a larger amount of investment from NASA than Blue Origin and NG Space; however the amounts sought by both Nanoracks and Blue Origin from NASA were roughly equivalent as far as a percentage of their proposed costs toward a CDR level of maturity. Nanoracks and Blue Origin are also planning to raise significant amounts of non-NASA investment compared to the investment being made from NASA, which will help maximize the impact of NASA's contribution. This non-NASA investment is an area that NG Space improved on as a result of due diligence discussions, but they will need to continue to work on during SAA implementation. Since NG Space is not proceeding as far in their development during the term of the SAA, I felt this proposed investment was appropriate.

In light of the discriminators I have described above, I select the following companies for award of funded Space Act Agreements under the Commercial LEO Destinations activity in the following amounts:

Blue Origin, LLC:	$130,000,000
Nanoracks:	$160,000,000
Northrop Grumman Systems Corporation:	$125,600,000

Philip R. McAlister _____

Philip R. McAlister
Selection Authority

12/01/2021 _____

Date