



Collaborations for Commercial Space Capabilities

Space Act Agreement SAA-QA-14-18884

Effective Date: December 18, 2014



AMENDMENTS AND HISTORY LOG

Status	Amend No.	Effective Date	DESCRIPTION
Baseline	N/A	12/18/14	Baseline Space Act Agreement

NONREIMBURSABLE SPACE ACT AGREEMENT
BETWEEN
THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
AND UNITED LAUNCH ALLIANCE
FOR COMMERCIAL SPACE CAPABILITIES COLLABORATION

ARTICLE 1. AUTHORITY AND PARTIES

In accordance with the National Aeronautics and Space Act (51 U.S.C. § 20113), this Agreement is entered into by the National Aeronautics and Space Administration (hereinafter referred to as "NASA") and United Launch Alliance located at 9501 East Panorama Circle, Centennial, CO 80112 (hereinafter referred to as "Partner" or *ULA*). NASA and Partner may be individually referred to as a "Party" and collectively referred to as the "Parties."

ARTICLE 2. PURPOSE

The purpose of this Agreement is to facilitate ULA's anticipated development of launch vehicle technologies that enable new capabilities while substantially reducing costs. These technologies will benefit the entire spectrum of launch users: NASA science, NASA crew, NASA cargo, National Security, Commercial Satellites and the emergent commercial human space flight market. The scope of the activity and alignment with NASA's strategy for human space exploration is described in the Executive Summary in Appendix 1. NASA is committed to advance commercial space-related efforts by facilitating access to NASA's vast spaceflight resources including technical expertise, assessments, lessons learned, and data. Accordingly the agency's Commercial Space Capabilities Office is partnering with ULA, through this agreement, to provide insight and assistance to ULA in its attempt to develop this capability.

ARTICLE 3. RESPONSIBILITIES

A. NASA will use reasonable efforts to:

1. Provide a point of contact for ULA within the Commercial Space Capabilities Office within 30 days after the effective date of this Agreement.
2. Provide access to requested NASA technical data, lessons learned, and expertise support as resources permit.
3. Review data provided by ULA.
4. Attend quarterly meetings with ULA regarding the past quarter's milestones and upcoming activities.
5. Within 30 days of each quarterly meeting, provide ULA a written acknowledgement of milestone completion if NASA ascertains that the milestones of the previous quarter have been accomplished. Nothing in the acknowledgement of milestone completion shall be construed to imply that NASA endorses or sponsors any ULA product or service resulting from activities conducted under this Agreement. NASA's acknowledgement shall not be construed to imply approval or endorsement of the safety, reliability or appropriateness of any ULA design, system, architecture or testing methodology.

6. Attend and observe ULA milestones, at its discretion and after coordination with ULA.

B. Partner will use reasonable efforts to:

1. Conduct its development program according to the milestones identified in Article 4 of this Agreement.
2. Provide NASA with data regarding its progress towards the milestones.
3. Conduct a quarterly meeting with NASA regarding the past quarter's milestones, demonstrating that the success criteria have been met, and discuss upcoming activities.

	specific to fit the requirements: see standard list of requirements in the table below.	
	PDR: Success criteria per ULA command media and tailored specific to fit the requirements: see standard list of requirements in the table below.	█ █
	CDR: Success criteria per ULA command media and tailored specific to fit the requirements: see standard list of requirements in the table below.	█ █
Cryo-Storage and Handling		
	MSFC atmospheric test: Success Criteria: Successfully demonstrate LN2 loading and expulsion; tank heating and pressurization efficiency	█ █
	█ █ █	█ █
	CRYOTE low boil-off Concept Design review: Success Criteria: Concurrence on the CRYOTE system enhancements to support low boil-off demonstration and testing objectives	█ █
	CRYOTE low boil-off testing: Success Criteria: Successfully demonstrate <0.5%/day LH2 boil-off (1/10 th best flight data).	█ █
	█ █ █	█ █
Upper Stage Mission Kit		
	Concept review TIM: Success Criteria: Sharing of concept concurrence on forward development plan	█
	TIM: Success Criteria: Concurrence with the design █ █	█ █
MLI / MMOD		
	Concept review TIM: Success Criteria: Sharing of concept concurrence on forward development plan	█
	White Sands Test: Success Criteria: Demonstrate that test article meets requirements	█ █
Advanced Welding		
	Concept review TIM: Success Criteria: Sharing of concept, concurrence on forward	█

	development plan	
	[REDACTED]	[REDACTED]
	[REDACTED]	
	[REDACTED]	
Additive Manufacturing		
	NASA MSFC TIM: Success criteria: ULA and NASA collaboration on proof of concept launch vehicle flight applications and sharing of materials and process data. [REDACTED]	Semi - Annual
Model Development		
	[REDACTED]	[REDACTED]
Upper Stage Applications		
	Concept review TIM: Success Criteria: Sharing of upper stages (current and future) and transportation architectures to meet mission requirements.	[REDACTED]
	Progress TIM: Success Criteria: Review progress of all proposal projects, how the respective technologies can be implemented into existing and future upper stages and potential benefits to missions of interest.	Quarterly

SRR Success Criteria		Evidence
A	Supporting incremental/precursor reviews are complete (if applicable) > All action items are closed or have agreed-to closure plans	
B	Program system requirements have been defined and allocated to subsystems and PDTs > Program (Customer) requirements defined > System Specification tree is defined > System requirements (including design and environmental requirements) are defined with verification approach > Specialty engineering and system safety requirements are defined	
C	System architecture / Conops defined > Mission analysis is complete and the Concept of Operations is developed > Functional and physical architectures are defined > System trades studies and analyses complete to allocate functional and performance requirements > Key system performance parameters are defined	
D	Risk and opportunities management plan defined > Initial risks identified and mitigation strategies defined > Lessons learned from related previous programs are reviewed (if applicable)	
E	Technical program management processes are defined including; 1) Design review plans, 2) technical decision making, 3) preliminary system verification plan, 4) configuration management, and 5) preliminary master test plan	
F	Program plan is defined including schedule, cost, resources, and issues/concerns	
G	Action items > Action Items have been documented and assigned. Action Items deemed constraints to the review have approved closure plans defined.	

PDR Success Criteria		Evidence
A	Supporting incremental / precursor design reviews are complete > All action items are closed or have approved closure plans	
B	Requirements are complete, traceable, and verifiable > System and lower-tier specifications are updated > Interface control documents are under configuration control (as required) > Closure plans are identified for "TBX" items > Specification tree is updated	
C	Concept of Operations updated and approved > Sequence of events and operating timelines are updated > Critical events are identified	
D	Preliminary design is established > Preliminary design complies with requirements > Lower level design and architecture trade studies and analyses are complete > Drawing tree is developed & preliminary system design drawings are complete	
E	Preliminary systems analyses complete > Preliminary system analyses (loads, stress, thermal, etc) are complete > Technical Performance Measures (TPMs) including margins are updated > Lessons learned from previous programs are reviewed and addressed (as applicable)	
F	Specialty engineering and system safety analyses of the preliminary design are complete and requirements implemented > Reliability; Parts, Materials & Processes; EMI/EMC; and Systems Safety requirements are implemented and preliminary analyses are complete	
G	Risk and opportunities are understood and actively managed > Remaining risks have acceptable closure plans defined	
H	Test, qualification, and verification plans are defined > Preliminary system verification plan is complete and verification matrix is updated > Preliminary program test plan is complete > "Test Like You Fly" exceptions/deviations have been identified	
I	Program plans are updated and validated as executable > Design approach is balanced across cost, schedule, performance, and risk for the life cycle > Integrated system costs and schedules are updated	
J	Preliminary manufacturing planning is defined > Long lead items adequately addressed	
K	Action items > Action Items have been documented and assigned. Action Items deemed constraints to the review have approved closure plans defined.	

CDR Success Criteria	
A	Supporting incremental / precursor design reviews are complete ➤ All action items are closed or have approved closure plans
B	Requirements are complete, traceable, and verifiable ➤ System and lower-tier specifications are updated with no "TBX" items
C	Detailed design is established and under baseline control* ➤ Detailed design drawings are sufficiently complete to proceed into the production phase ➤ Software architecture and internal interfaces are finalized ➤ Detailed design complies with requirements
D	Detailed system analysis is complete ➤ Detailed systems analyses (loads, stress, thermal, etc.) are complete ➤ Specialty engineering and system safety analyses are complete ➤ Reliability; Parts, Materials & Processes; EMI/EMC; Quality; and System Safety requirements are implemented and analyses updated as applicable
E	Risk and opportunities are understood and actively managed ➤ Remaining risks have acceptable mitigation plans defined ➤ Lessons learned from previous programs are reviewed and addressed ➤ Technical Performance Measures (TPMs) including margins are updated
F	Test, qualification, and verification plans are defined ➤ Master test plan is complete ➤ "Test Like You Fly" exceptions/deviations have been identified ➤ Hardware and Software test requirements are defined ➤ Hardware and software development and test facilities and tools are defined ➤ System verification plan is complete and verification matrix is updated
G	Manufacturing plan is defined ➤ Producibility trades and assessments are complete ➤ Manufacturing planning is complete and manufacturing processes and equipment are defined ➤ Assembly and integration procedures are updated ➤ Long lead items are identified and adequately addressed
H	Program plans are updated and validated as executable** ➤ Design approach is balanced across cost, schedule, performance, and risk for the life cycle ➤ Integrated system costs and schedules are updated
I	Action Items ➤ Action Items have been documented and assigned. Action Items deemed constraints to the review have approved closure plans defined.

ARTICLE 5. FINANCIAL OBLIGATIONS

There will be no transfer of funds between the Parties under this Agreement and each Party will fund its own participation. All activities under or pursuant to this Agreement are subject to the availability of funds, and no provision of this Agreement shall be interpreted to require obligation or payment of funds in violation of the Anti-Deficiency Act, (31 U.S.C. § 1341).

ARTICLE 6. PRIORITY OF USE

Any schedule or milestone in this Agreement is estimated based upon the Parties' current understanding of the projected availability of NASA goods, services, facilities, or equipment. In the event that NASA's projected availability changes, Partner shall be given reasonable notice of that change, so that the schedule and milestones may be adjusted accordingly. The Parties agree that NASA's use of the goods, services, facilities, or equipment shall have priority over the use planned in this Agreement. Should a conflict arise, NASA in its sole discretion shall determine whether to exercise that priority. Likewise, should a conflict arise as between two or more non-NASA Partners, NASA, in its sole discretion, shall determine the priority as between those Partners. This Agreement does not obligate NASA to seek alternative government property or services under the jurisdiction of NASA at other locations.

ARTICLE 7. NONEXCLUSIVITY

This Agreement is not exclusive; accordingly, NASA may enter into similar agreements for the same or similar purpose with other private or public entities.

ARTICLE 8. LIABILITY AND RISK OF LOSS

A. Partner hereby waives any claims against NASA, its employees, its related entities, (including, but not limited to, contractors and subcontractors at any tier, grantees, investigators, customers, users, and their contractors and subcontractors, at any tier) and employees of NASA's related entities for any injury to, or death of, Partner employees or the employees of Partner's related entities, or for damage to, or loss of, Partner's property or the property of its related entities arising from or related to activities conducted under this Agreement, whether such injury, death, damage, or loss arises through negligence or otherwise, except in the case of willful misconduct.

B. Partner further agrees to extend this unilateral waiver to its related entities by requiring them, by contract or otherwise, to waive all claims against NASA, its related entities, and employees of NASA and employees of NASA's related entities for injury, death, damage, or loss arising from or related to activities conducted under this Agreement.

ARTICLE 9. INTELLECTUAL PROPERTY RIGHTS - DATA RIGHTS

A. General

1. "Related Entity" as used in this Data Rights Article means a contractor, subcontractor, grantee, or other entity having a legal relationship with NASA or Partner that is assigned, tasked, or contracted to perform activities under this Agreement.
2. "Data" means recorded information, regardless of form, the media on which it is recorded, or the method of recording.
3. "Proprietary Data" means Data embodying trade secrets developed at private expense or commercial or financial information that is privileged or confidential, and that includes a restrictive notice, unless the Data is:
 - a. known or available from other sources without restriction;
 - b. known, possessed, or developed independently, and without reference to the Proprietary Data;
 - c. made available by the owners to others without restriction; or
 - d. required by law or court order to be disclosed.
4. Data exchanged under this Agreement is exchanged without restriction except as otherwise provided herein.
5. Notwithstanding any restrictions provided in this Article, the Parties are not restricted in the use, disclosure, or reproduction of Data provided under this Agreement that meets

one of the exceptions in 3., above. If a Party believes that any exceptions apply, it shall notify the other Party before any unrestricted use, disclosure, or reproduction of the Data.
6. RESERVED.

7. If the Parties exchange Data having a notice that the Receiving Party deems is ambiguous or unauthorized, the Receiving Party shall tell the Providing Party. If the notice indicates a restriction, the Receiving Party shall protect the Data under this Article unless otherwise directed in writing by the Providing Party.

8. The Data rights herein apply to the employees and Related Entities of Partner. Partner shall ensure that its employees and Related Entity employees know about and are bound by the obligations under this Article.

9. Disclaimer of Liability: NASA is not restricted in, or liable for, the use, disclosure, or reproduction of Data without a restrictive notice under paragraphs A.3., B. or H. of this Article or for Data Partner gives, or is required to give, the U.S. Government without restriction.

10. Partner may use a restrictive notice under paragraphs A.3., B. and H. of this Article. When delivered or otherwise furnished to NASA under this Agreement, data shall be marked with a conspicuous legend indicating that the data is the proprietary information of United Launch Alliance. Additional restrictive markings may be utilized, including but not limited to those relating to export control laws, protection of third party proprietary information and claiming exemption from disclosure under the Freedom of Information Act 5 U.S.C. 552. NASA agrees to honor all existing markings affixed to documents that are provided to NASA under this Agreement.

B. Data First Produced by Partner Under this Agreement

[REDACTED]

C. Data First Produced by NASA Under this Agreement

If Partner requests that Data first produced by NASA or its Related Entities under this Agreement be protected, and NASA determines it would be Proprietary Data if obtained from Partner, NASA will mark it with a restrictive notice and use reasonable efforts to protect it for five (5) years after its development. During this restricted period the Data may be disclosed and used (under suitable protective conditions) for U.S. Government purposes only, and thereafter for any purpose. Partner must not disclose the Data without

NASA's written approval during the restricted period. The restrictions placed on NASA do not apply to Data disclosing a NASA owned invention for which patent protection is being considered.

NASA will not incorporate any Proprietary Data of Partner into any data first produced by NASA without the express written permission of Partner and subject to reasonable protections that Partner may require.

D. Publication of Results

The National Aeronautics and Space Act (51 U.S.C. § 20112) requires NASA to provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof. As such, NASA may publish unclassified and non-Proprietary Data resulting from work performed under this Agreement. The Parties will coordinate publication of results allowing a reasonable time to review and comment.

E. Data Disclosing an Invention

If the Parties exchange Data disclosing an invention for which patent protection is being considered, and the furnishing Party identifies the Data as such when providing it to the Receiving Party, the Receiving Party shall withhold it from public disclosure for a reasonable time two (2) years unless otherwise agreed or the Data is restricted for a longer period herein).

F. Copyright

Data exchanged with a copyright notice and no indication of restriction under paragraphs A.3., B, C, or H of this Article (*i.e.*, Data has no restrictive notice) is presumed to be published. The following royalty-free licenses apply.

1. If indicated on the Data that it was produced outside of this Agreement, it may be reproduced, distributed, and used to prepare derivative works only for carrying out the Receiving Party's responsibilities under this Agreement.
2. Data without the indication of 1. is presumed to be first produced under this Agreement. Except as otherwise provided in paragraph E. of this Article, and in the *Invention and Patent Rights* Article of this Agreement for protection of reported inventions, the Data may be reproduced, distributed, and used to prepare derivative works for any purpose.

G. Data Subject to Export Control

Whether or not marked, technical data subject to the export laws and regulations of the United States provided to Partner under this Agreement must not be given to foreign persons or transmitted outside the United States without proper U.S. Government authorization.

H. Handling of Background, Third Party Proprietary, and Controlled Government Data

If Partner discloses Proprietary Data orally or visually, NASA will have no duty to restrict, or liability for disclosure or use, unless Partner:

1. Orally informs NASA before initial disclosure that the Data is Proprietary Data, and
2. Reduces the Data to tangible form with a restrictive notice as required by paragraphs A.3., B, and H of this Article, and gives it to NASA within ten (10) calendar days after disclosure.

ARTICLE 10. INTELLECTUAL PROPERTY RIGHTS - INVENTION AND PATENT RIGHTS

A. General

1. NASA has determined that 51 U.S.C. § 20135(b) does not apply to this Agreement. Therefore, title to inventions made (conceived or first actually reduced to practice) under this Agreement remain with the respective inventing party(ies). No invention or patent rights are exchanged or granted under this Agreement, except as provided herein.
2. “Related Entity” as used in this Invention and Patent Rights Article means a contractor, subcontractor, grantee, or other entity having a legal relationship with NASA or Partner assigned, tasked, or contracted with to perform activities under this Agreement.
3. The invention and patent rights herein apply to employees and Related Entities of Partner. Partner shall ensure that its employees and Related Entity employees know about and are bound by the obligations under this Article.

B. NASA Inventions

NASA will use reasonable efforts to report inventions made under this Agreement by its employees. Upon request, NASA will use reasonable efforts to grant Partner, under 37 C.F.R. Part 404, a negotiated license to any NASA invention made under this Agreement. This license is subject to paragraph E.1. of this Article.

C. NASA Related Entity Inventions

NASA will use reasonable efforts to report inventions made under this Agreement by its Related Entity employees, or jointly between NASA and Related Entity employees, where NASA has the right to acquire title. Upon request, NASA will use reasonable efforts to grant Partner, under 37 C.F.R. Part 404, a negotiated license to any of these inventions where NASA has acquired title. This license is subject to paragraph E.2. of this Article.

D. Joint Inventions With Partner

The Parties will use reasonable efforts to report, and cooperate in obtaining patent protection on, inventions made jointly between NASA employees, Partner employees, and employees of either Party’s Related Entities. Upon timely request, NASA may, at its sole discretion and subject to paragraph E. of this Article:

1. refrain from exercising its undivided interest inconsistently with Partner's commercial business; or
2. use reasonable efforts to grant Partner, under 37 C.F.R. Part 404, an exclusive or partially exclusive negotiated license.

E. Rights to be Reserved in Partner's License

Any license granted Partner under paragraphs B., C., or D. of this Article is subject to the following:

1. For inventions made solely or jointly by NASA employees, NASA reserves the irrevocable, royalty-free right of the U.S. Government to practice the invention or have it practiced on behalf of the United States or on behalf of any foreign government or international organization pursuant to any existing or future treaty or agreement with the United States.
2. For inventions made solely or jointly by employees of a NASA Related Entity, NASA reserves the rights in 1. above, and a revocable, nonexclusive, royalty-free license retained by the Related Entity under 14 C.F.R. § 1245.108 or 37 C.F.R. § 401.14 (e).

F. Protection of Reported Inventions

For inventions reported under this Article, the Receiving Party shall withhold all invention reports or disclosures from public access for a reasonable time (1 year unless otherwise agreed or unless restricted longer herein) to facilitate establishment of patent rights.

G. Patent Filing Responsibilities and Costs

1. The invention and patent rights herein apply to any patent application or patents covering an invention made under this Agreement. Each Party is responsible for its own costs of obtaining and maintaining patents covering sole inventions of its employees. The Parties may agree otherwise, upon the reporting of any invention (sole or joint) or in any license granted.
2. Partner shall include the following in patent applications for an invention made jointly between NASA employees, its Related Entity employees and Partner employees:

The invention described herein may be manufactured and used by or for the U.S. Government for U.S. Government purposes without the payment of royalties thereon or therefore.

ARTICLE 11. RELEASE OF GENERAL INFORMATION TO THE PUBLIC AND MEDIA

NASA or Partner may, consistent with Federal law and this Agreement, release general information regarding its own participation in this Agreement as desired.

ARTICLE 12. USE OF NASA NAME AND EMBLEMS

A. NASA Name and Initials

Partner shall not use "National Aeronautics and Space Administration" or "NASA" in a way that creates the impression that a product or service has the authorization, support, sponsorship, or endorsement of NASA, which does not, in fact, exist. Except for releases under the "Release of General Information to the Public and Media" Article, Partner must submit any proposed public use of the NASA name or initials (including press releases and all promotional and advertising use) to the NASA Associate Administrator for the Office of Communications or designee ("NASA Communications") for review and approval. Approval by NASA Office of Communications shall be based on applicable law and policy governing the use of the NASA name and initials.

B. NASA Emblems

Use of NASA emblems (i.e., NASA Seal, NASA Insignia, NASA logotype, NASA Program Identifiers, and the NASA Flag) is governed by 14 C.F.R. Part 1221. Partner must submit any proposed use of the emblems to NASA Communications for review and approval.

ARTICLE 13. DISCLAIMER OF WARRANTY

Goods, services, facilities, or equipment provided by NASA under this Agreement are provided "as is." NASA makes no express or implied warranty as to the condition of any such goods, services, facilities, or equipment, or as to the condition of any research or information generated under this Agreement, or as to any products made or developed under or as a result of this Agreement including as a result of the use of information generated hereunder, or as to the merchantability or fitness for a particular purpose of such research, information, or resulting product, or that the goods, services, facilities or equipment provided will accomplish the intended results or are safe for any purpose including the intended purpose, or that any of the above will not interfere with privately-owned rights of others. Neither the government nor its contractors shall be liable for special, consequential or incidental damages attributed to such equipment, facilities, technical information, or services provided under this Agreement or such research, information, or resulting products made or developed under or as a result of this Agreement.

ARTICLE 14. DISCLAIMER OF ENDORSEMENT

NASA does not endorse or sponsor any commercial product, service, or activity. NASA's participation in this Agreement or provision of goods, services, facilities or equipment under this Agreement does not constitute endorsement by NASA. Partner agrees that nothing in this Agreement will be construed to imply that NASA authorizes, supports, endorses, or sponsors any product or service of Partner resulting from activities conducted under this Agreement, regardless of the fact that such product or service may employ NASA-developed technology.

ARTICLE 15. COMPLIANCE WITH LAWS AND REGULATIONS

A. The Parties shall comply with all applicable laws and regulations including, but not limited to, safety; security; export control; environmental; and suspension and debarment laws and regulations. Access by a Partner to NASA facilities or property, or to a NASA Information Technology (IT) system or application, is contingent upon compliance with NASA security and safety policies and guidelines including, but not limited to, standards on badging, credentials, and facility and IT system/application access.

B. With respect to any export control requirements:

1. The Parties will comply with all U.S. export control laws and regulations, including the International Traffic in Arms Regulations (ITAR), 22 C.F.R. Parts 120 through 130, and the Export Administration Regulations (EAR), 15 C.F.R. Parts 730 through 799, in performing work under this Agreement or any Annex to this Agreement. In the absence of available license exemptions or exceptions, the Partner shall be responsible for obtaining the appropriate licenses or other approvals, if required, for exports of hardware, technical data and software, or for the provision of technical assistance.

2. The Partner shall be responsible for obtaining export licenses, if required, before utilizing foreign persons in the performance of work under this Agreement or any Annex under this Agreement, including instances where the work is to be performed on-site at NASA and where the foreign person will have access to export-controlled technical data or software.

3. The Partner will be responsible for all regulatory record-keeping requirements associated with the use of licenses and license exemptions or exceptions.

4. The Partner will be responsible for ensuring that the provisions of this Article apply to its Related Entities.

C. With respect to suspension and debarment requirements:

1. The Partner hereby certifies, to the best of its knowledge and belief, that it has complied, and shall comply, with 2 C.F.R. Part 180, Subpart C, as supplemented by 2 C.F.R. Part 1880, Subpart C.

2. The Partner shall include language and requirements equivalent to those set forth in subparagraph C.1., above, in any lower-tier covered transaction entered into under this Agreement.

ARTICLE 16. TERM OF AGREEMENT

This Agreement becomes effective upon the date of the last signature below (“Effective Date”) and shall remain in effect until the completion of all obligations of both Parties hereto, or March 31, 2017, whichever comes first.

ARTICLE 17. RIGHT TO TERMINATE

Either Party may unilaterally terminate this Agreement by providing thirty (30) calendar days written notice to the other Party.

ARTICLE 18. CONTINUING OBLIGATIONS

The rights and obligations of the Parties that, by their nature, would continue beyond the expiration or termination of this Agreement, e.g., "Liability and Risk of Loss" and "Intellectual Property Rights" related shall survive such expiration or termination of this Agreement.

ARTICLE 19. POINTS OF CONTACT

The following personnel are designated as the Points of Contact between the Parties in the performance of this Agreement.

NASA

Alan Lindenmoyer
Manager, Commercial Space Capabilities
Office
alan.j.lindenmoyer@nasa.gov
Telephone: 281-244-7064
Cell: 281-630-4841
Fax: 281-483-5970
NASA Johnson Space Center
2101 NASA Parkway
Code QA
Houston, Texas 77058

United Launch Alliance

Diem Reising
Contracts Administrator
[REDACTED]
Telephone: [REDACTED]
Cell: [REDACTED]
Fax: 303-269-6589
7670 South Chester Street
Centennial, CO 80112
Mail Stop: D2500

ARTICLE 20. DISPUTE RESOLUTION

Except as otherwise provided in the Article entitled "Priority of Use," the Article entitled "Intellectual Property Rights – Invention and Patent Rights" (for those activities governed by 37 C.F.R. Part 404), and those situations where a pre-existing statutory or regulatory system exists (e.g., under the Freedom of Information Act, 5 U.S.C. § 552), all disputes concerning questions of fact or law arising under this Agreement shall be referred by the claimant in writing to the appropriate person identified in this Agreement as the "Points of Contact." The persons identified as the "Points of Contact" for NASA and the Partner will consult and attempt to

resolve all issues arising from the implementation of this Agreement. If they are unable to come to agreement on any issue, the dispute will be referred to the signatories to this Agreement, or their designees, for joint resolution. If the Parties remain unable to resolve the dispute, then the NASA signatory or that person's designee, as applicable, will issue a written decision that will be the final agency decision for the purpose of judicial review. Nothing in this Article limits or prevents either Party from pursuing any other right or remedy available by law upon the issuance of the final agency decision.

ARTICLE 21. MODIFICATIONS

Any modification to this Agreement shall be executed, in writing, and signed by an authorized representative of NASA and the Partner.

ARTICLE 22. ASSIGNMENT

Neither this Agreement nor any interest arising under it will be assigned by the Partner or NASA without the express written consent of the officials executing, or successors, or higher- level officials possessing original or delegated authority to execute this Agreement.

ARTICLE 23. APPLICABLE LAW

U.S. Federal law governs this Agreement for all purposes, including, but not limited to, determining the validity of the Agreement, the meaning of its provisions, and the rights, obligations and remedies of the Parties.

ARTICLE 24. INDEPENDENT RELATIONSHIP

This Agreement is not intended to constitute, create, give effect to or otherwise recognize a joint venture, partnership, or formal business organization, or agency agreement of any kind, and the rights and obligations of the Parties shall be only those expressly set forth herein.

ARTICLE 25. SIGNATORY AUTHORITY

The signatories to this Agreement covenant and warrant that they have authority to execute this Agreement. By signing below, the undersigned agrees to the above terms and conditions.

NATIONAL AERONAUTICS AND SPACE
ADMINISTRATION

UNITED LAUNCH ALLIANCE

BY: Philip R. McAlister
Philip R. McAlister
Director, Commercial Spaceflight
Development Division

BY: Diem Reising
Diem Reising
Contracts Administrator

DATE: 12/18/2014

DATE: 10 November 2014

Appendix 1 Executive Summary

Capabilities Planned by the Company

United Launch Alliance (ULA) proposes collaborating with NASA to develop launch vehicle technologies that enable new capabilities while substantially reducing cost. The proposed technologies are broadly applicable to ULA's Atlas V and Delta IV launch vehicles, and to NASA's SLS.

ULA provides a full spectrum of launch capabilities including: launch vehicle design, production, launch and payload delivery to the required orbit. ULA (including our heritage companies) has accumulated over five decades of experience conducting over 500 space launches, delivering payloads to a wide range of destinations including LEO, GTO, MEO, GSO and Earth escape with payloads launched to every planet. This experience is guiding a rebirth at ULA as we pursue revolutionizing launch by enabling more capability and mission flexibility at drastically lower costs.

Purpose of the Proposed Partnership

The purpose of the proposed partnership is for ULA and NASA to share expertise and ongoing development to enhance both NASA's and ULA's capability to meet our respective charters. For the proposed hardware development collaboration ULA will provide hardware for testing by NASA with both NASA and ULA reaping the benefits of the test results.

Upper Stage Technology Focus/Application and Benefit

- H2/O2 Thruster: Consume GH2 and GO2 from upper stage tanks to eliminate storable, hazardous propellant extending mission duration from hours to days/weeks while also providing mission flexibility through highly efficient thrust capability.
- Integrated Vehicle Fluids: Consume H2 and O2 from upper stage tanks to provide power and autogenous pressurant extending mission duration from hours to weeks while also providing mission flexibility and improved performance.
- Fuel Cell: Consume GH2 and GO2 from upper stage tanks to provide power, extending mission duration from hours to weeks.
- Low Cost Propulsion: Develop RL10 class engine with innovative system approach reducing costs by 80%.
- Cryo Storage and Handling: Efficiently store and transfer LH2 and LO2 to extend mission duration from hours to weeks while also enabling refueling of cryogenic stages to dramatically increase performance.
- Upper Stage Mission Kits: Develop mission kits enabling upper stages to perform unique capabilities including rendezvous and direct delivery of payloads to planetary surfaces eliminating cost of dedicated lander.

Appendix 1 Executive Summary

- **Advanced Avionics:** Develop next generation, low cost avionics for control of Integrated Vehicle Fluids and launch vehicles that enables new mission capabilities such as rendezvous and landing.
- **MMOD:** Pursue advanced, light weight MMOD protection supporting upper stage applications, both cryo & ambient vehicle elements.

Upper Stage Manufacturing Focus

- **Advanced Welding:** Apply friction stir welding and other modern welding technologies to thin materials that offer to reduce costs, inspection, and tank mass by increasing joint strength.
- **Additive Manufacturing:** Use additive manufacturing to optimize design and reduce cost.

Upper Stage Systems Focus

- **Modeling:** Pursues enhanced analytic modeling to support launch vehicle development and recurring ops.
- **Upper Stage Application Study:** Application of above technologies into an integrated stage that provides enhanced mission capabilities at reduced cost.

Relevance to NASA

The proposed collaboration helps enable NASA's strategic goal to "Expand the frontiers of knowledge, capability, and opportunity in space" by enhancing America's launch capability. This enhanced launch capability strives to dramatically reduce the cost of space access while simultaneously enabling delivery of payloads throughout cis-lunar space, including directly to the lunar surface without the nearly insurmountable multi-billion dollar cost barrier of developing a dedicated lunar lander. These enhanced transportation capabilities are designed to evolve to support future crewed missions to near Earth asteroids and Mars. ULA's mission is to support all users of space: NASA, national security and commercial. We are actively flying a broad range of NASA, national security and commercial payloads. At the same time we are aggressively supporting emerging customers including crew, cargo and commercial human spaceflight beyond low Earth orbit.

Appendix 1 Executive Summary

Business and Technical Approach, Including Why NASA Should Have Confidence in the Company's Ability to Complete the Proposed Capabilities

ULA is currently pursuing all of the above capabilities supported by ULA investment as well as NASA and Department of Defense funding. We are already collaborating with NASA developing many of these technologies, both informally and codified under various agreements. Greater collaboration with NASA will help accelerate development and implementation of these enabling technologies.



Government Resources Requested Under the Proposed Partnership

NASA and ULA represent the majority of America's launch vehicle capabilities, especially as it applies to cryogenic upper stages.

- ULA requests technical interchange with NASA experts pursuing related capabilities, sharing hard-won lessons will accelerate development.
- Investigation by NASA to determine potential benefit of these technologies to NASA missions.
- Access to NASA labs and testing in NASA facilities including: 3D printing, Exploration Systems Test Facility, TS-300. Includes NASA personal support & testing commodities.

**Appendix 2
Background Data**

Data Description
H2/O2 Thruster - Technology overview
Integrated Vehicle Fluids - Technology overview
Fuel Cell - Technology overview
Low Cost Propulsion - Technology overview
Cryo Fluid Mgmt - Technology overview
Upper Stage Mission Kit - Technology overview
Advanced Avionics - Technology overview
MLI/MMOD - Technology overview
Advanced Welding - Technology overview
Additive Manufacturing - Technology overview
Model development - Technology overview
Upper Stage Application Study - Technology overview