

ANNEX NO. 3  
BETWEEN  
THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
LANGLEY RESEARCH CENTER  
AND  
UNITED LAUNCH ALLIANCE, LLC  
UNDER  
REIMBURSABLE SPACE ACT UMBRELLA AGREEMENT SAA1-37876  
FOR  
VERA SPLASHDOWN ANALYSIS

ARTICLE 1. PURPOSE

This Annex shall be for the purpose of supporting United Launch Alliance (ULA) commercial space transportation development activities to include design, development, testing and launch vehicle integration of Hypersonic Inflatable Aerodynamic Decelerators (HIAD) through VERA splashdown analysis. Efforts include analyzing existing NASA water landing test data, developing water landing dynamic models, deriving ocean landing conditions, and formulating future water landing tests.

The legal authority for this Annex, consistent with the Umbrella Agreement, is in accordance with the Space Act, Other Transactions Authority (OTA), 51 U.S.C. § 20113(e).

ARTICLE 2. RESPONSIBILITIES

A. NASA LaRC will use reasonable efforts to:

1. Participate in periodic virtual meetings with ULA related to water landing activities and an on-site Technical Interchange Meeting (TIM) at ULA facilities.
2. Provide existing NASA water impact test data and LS-DYNA results to ULA with guidance on interpretation and application to ULA splashdown simulations.
3. Provide SME consultation to ULA during ULA rigid and flexible model splashdown analysis.
4. Use ocean landing experience from previous NASA programs to establish dispersed ocean landing conditions for VERA.
5. Evaluate VERA water landing capabilities and formulate VERA splashdown mitigations and future test campaigns in collaboration with ULA.

B. Partner will use reasonable efforts to:

1. Participate in periodic virtual meetings with NASA related to water landing activities and host an on-site TIM.
2. Conduct and compare Abaqus (ULA) and existing LS-DYNA (NASA) rigid model splashdown simulation results and share analysis with NASA.

3. Conduct Abaqus (ULA) Flexible Model Splashdown Analysis based on dispersed VERA ocean landing conditions.
4. Evaluate VERA water landing capabilities and formulate VERA splashdown mitigations and future test campaigns in collaboration with NASA.

ARTICLE 3. SCHEDULE AND MILESTONES

The planned major milestones for the activities for this Annex defined in the "Responsibilities" Article are as follows:

1. Authority to Proceed.	Upon Effective Date of Agreement + Availability of Partner Funding at NASA
2. NASA and ULA to Participate in Virtual Meetings and an on-site TIM at ULA facilities.	As Mutually Agreed Upon by the Parties
3. NASA to Deliver Existing Water Impact Test Data to ULA.	Within one (1) month following Milestone 1
4. ULA to Conduct and Compare Abaqus (ULA) and Existing LS-DYNA (NASA) Rigid Model Splashdown Simulation Results and Share Analysis with NASA.	Within two (2) months following Milestone 3
5. NASA to Establish Dispersed Ocean Landing Conditions.	Within one (1) month following Milestone 4
6. ULA to Conduct Abaqus (ULA) Flexible Model Splashdown Analysis.	Within two (2) months following Milestone 5
7. ULA and NASA to Evaluate VERA Water Landing Capabilities and Formulate VERA Splashdown Mitigations and Future Test Plans.	Within one (1) month following Milestone 6

ARTICLE 4. FINANCIAL OBLIGATIONS

A. Partner agrees to reimburse NASA an estimated cost of \$182,305.86 for NASA to carry out its responsibilities under this Annex.

Each payment shall be marked with LaRC SAA1-37876, Annex 3.

B. NASA will not provide services or incur costs beyond the current funding. Although NASA has made a good faith effort to accurately estimate its costs, it is understood that NASA provides no assurance that the proposed effort under this Annex will be accomplished for the estimated amount. Should the effort cost more than the estimate, Partner will be advised by NASA as soon as possible. Partner shall pay all costs incurred and have the option of canceling the remaining effort or providing additional funding in order to continue the proposed effort under the revised estimate. Should this Annex be

terminated, or the effort completed at a cost less than the agreed-to estimated cost, NASA shall account for any unspent funds within one year after completion of all effort under this Annex, and promptly thereafter, at Partner's option return any unspent funds to Partner or apply any such unspent funds to other activities under the Umbrella Agreement. Return of unspent funds will be processed via Electronic Funds Transfer (EFT) in accordance with 31 C.F.R. Part 208 and, upon request by NASA, Partner agrees to complete the Automated Clearing House (ACH) Vendor/Miscellaneous Payment Enrollment Form (SF 3881).

#### ARTICLE 5. INTELLECTUAL PROPERTY RIGHTS - DATA RIGHTS

A. Data produced under this Annex which is subject to paragraph C. of the Intellectual Property Rights - Data Rights Article of the Umbrella Agreement will be protected for the period of one (1) year.

B. Under paragraph H. of the Intellectual Property Rights - Data Rights Article of the Umbrella Agreement, Disclosing Party provides the following Data to Receiving Party. The lists below may not be comprehensive, are subject to change, and do not supersede any restrictive notice on the Data provided.

1. Background Data: *The Disclosing Party's Background Data, if any, will be identified in a separate technical document.*
2. Third Party Proprietary Data: *The Disclosing Party's Third-Party Proprietary Data, if any, will be identified in a separate technical document.*
3. Controlled Government Data: *The Disclosing Party's Controlled Government Data, if any, will be identified in a separate technical document.*
4. The following software and related Data will be provided to Partner under a separate Software Usage Agreement: *None*

#### ARTICLE 6. TERM OF ANNEX

This Annex 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 one (1) year from the Effective Date, whichever comes first, unless such term exceeds the duration of the Umbrella Agreement. The term of this Annex shall not exceed the term of the Umbrella Agreement. The Annex automatically expires upon the expiration of the Umbrella Agreement.

#### ARTICLE 7. TERMINATION

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

#### ARTICLE 8. POINTS OF CONTACT

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

Management Points of Contact	
<u>NASA Langley Research Center</u> Joseph Del Corso Project Manager, Vulcan Engine Recovery Aeroshell (VERA) Mail Stop: 104 Hampton, VA 23681 Phone: 757.864.9441 Email: joseph.a.delcorso@nasa.gov	<u>United Launch Alliance, LLC</u> Caleb Weiss Program Manager 9501 E. Panorama Circle Centennial, CO 80112-3401 Phone: 303.391.4630 Email: caleb.c.weiss@ulalaunch.com
Technical Points of Contact	
<u>NASA Langley Research Center</u> F. McNeil Cheatwood Senior Technologist for Planetary Entry, Descent, and Landing Mail Suite: 489 Hampton, VA 23681 Phone: 757.864.2984 Email: f.m.cheatwood@nasa.gov	<u>United Launch Alliance, LLC</u> Caleb Weiss Program Manager 9100 East Mineral Circle Centennial, CO 80112-3401 Phone: 303.391.4630 Email: caleb.c.weiss@ulalaunch.com

**ARTICLE 9. MODIFICATIONS**

Any modification to this Annex shall be executed, in writing, and signed by an authorized representative of NASA and the Partner. Modification of an Annex does not modify the terms of the Umbrella Agreement.

**ARTICLE 10. SIGNATORY AUTHORITY**

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

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LANGLEY RESEARCH CENTER	UNITED LAUNCH ALLIANCE, LLC
BY: _____ Gregory Stover Director, Space Technology & Exploration Directorate	BY: _____ Don Tidwell Contract Administrator
DATE: _____	DATE: _____