SPACE ACT AGREEMENT
BETWEEN
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
AND
ORBITAL CORPORATION
FOR
COMMERCIAL ORBITAL TRANSPORTATION SERVICES DEMONSTRATION
(COTS)

BACKGROUND

A. NASA has established the Commercial Crew and Cargo Program Office at the Johnson Space Center as part of the Exploration Systems Mission Directorate. The objectives of the Commercial Crew and Cargo Program are to:

- implement U.S. Space Exploration policy with investments to stimulate the commercial space industry,
- facilitate U.S. private industry demonstration of cargo and crew space transportation capabilities with the goal of achieving safe, reliable, cost effective access to low-Earth orbit, and
- create a market environment in which commercial space transportation services are available to Government and private sector customers.

B. This Space Act Agreement represents ORBITAL's and NASA's commitment to conducting the initial development and demonstration phase of the Commercial Orbital Transportation Services (COTS) project. Specifically, the ORBITAL approach to meeting the goals of the project as described in Appendix 1 to this Agreement.

ARTICLE 1. AUTHORITY

This Agreement is entered into by the National Aeronautics and Space Administration, located at 4th and E Streets, SW, Washington, D.C. (hereinafter referred to as "NASA" or Government), and Orbital Sciences Corporation, (hereinafter referred to as "ORBITAL" or "Participant") with a place of business at 21839 Atlantic Boulevard, Dulles, Virginia 20166. NASA and ORBITAL may be individually referred to as a "Party" and collectively referred to as the "Parties." NASA's authority to enter into this Agreement is in accordance with the authority set forth in Sections 203(c)(5) and 203(c)(6) of the National Aeronautics and Space Act of 1958, as amended and NPD 1050.1H. This agreement will be implemented by NASA at the Lyndon B. Johnson Space Center in Houston, Texas.

ARTICLE 2. PURPOSE

The purpose of this Agreement is to conduct the initial development and demonstration phase of the Commercial Orbital Transportation Services (COTS) project. Under this Agreement, ORBITAL will receive milestone payments from NASA to develop and demonstrate vehicles, systems, and operations needed for ORBITAL to perform earth to orbit space flight demonstrations of the following capabilities:

> Capability A: External cargo delivery and disposal – delivers cargo (payloads) that operate directly in the space environment to a LEO test bed and provides for its safe disposal.
>
> Capability B: Internal cargo delivery and disposal – delivers cargo (payloads) that operates within a volume maintained at normal atmospheric pressure to a LEO test bed and provides for its safe disposal.

As part of the demonstrations, NASA will provide the International Space Station (ISS) for use by Orbital as an orbital destination and active test bed on the condition that Orbital satisfies the following applicable ISS visiting vehicle requirements:

- SSP 50808 ISS to COTS IRD
- SSP 50833 Cargo Transport Requirements Doc

The scope of the COTS Project and Demonstrations involves the development and operation of an end-to-end space transportation system of services including ground operations and integration, launch, rendezvous, proximity operations, docking or berthing, orbital operations, and safe disposal.

ARTICLE 3. RESPONSIBILITIES

A. ORBITAL shall:

(1) Conduct the COTS Demonstrations according to the milestones identified in Appendix 2 to this Agreement.

(2) Lead a quarterly project status briefing.

(3) Designate at least one seat on each review board described in Appendix 2 for a NASA representative.

(4) Support the development and baseline of a Joint ISS Integration Plan due within 60 days of Milestone 1 completion.

(5) Invite NASA to participate in Taurus II launch vehicle design reviews, which launch vehicle is being separately developed under ORBITAL IR&D project and other private funding.

B. NASA shall:

(1) Provide milestone payments to ORBITAL upon successful completion of each milestone, subject to limitations noted below.

(2) Provide the ISS as an orbital destination and active test bed if the ISS visiting vehicle requirements are satisfied. NASA will provide associated technical expertise to facilitate proximity operations, specifically rendezvous and Space Station Remote Manipulator System (SSRMS) capture.

(3) Provide relevant NASA data/information necessary for participant to provide for Visiting Vehicle Integration (VVI) requirements consistent with SSP 50808, the ISS to COTS Interface Requirements Document (IRD).

(4) Participate in the quarterly project status review.

(5) Appoint a NASA representative to participate in each review board described in Appendix 2, who shall have concurrence authority on aspects of the space transportation system design, engineering and operations, which affect the ISS or NASA crew members.

(6) Develop and baseline a Joint ISS Integration Plan (JIIP) within 60 days of Milestone 1 completion. The JIIP shall establish the overall verification strategy for demonstrating compliance with the applicable requirements defined in the ISS to COTS IRD and identifies other products, materials, and facilities that shall be exchanged between NASA and Orbital to support the ISS integration tasks necessary for completing the Phase 1 Demonstration.

(7) NASA at its discretion may participate in ORBITAL's Taurus II design reviews.

ARTICLE 4. SCHEDULE AND MILESTONES

The scheduled major milestones and acceptance criteria for each milestone for the COTS Demonstrations are identified in Appendix 2 to this Agreement

ARTICLE 5. FINANCIAL OBLIGATIONS

A. Obligation

(1) The Government's liability to make payments to ORBITAL is limited to only those funds obligated annually under this Agreement or by amendment to this Agreement. NASA may obligate funds to this Agreement incrementally.

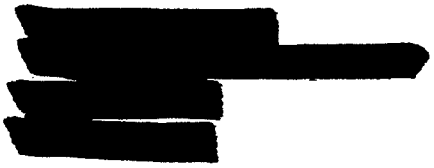
B. Acceptance and Payment for Milestones

(1) ORBITAL shall notify the NASA Key Personnel at least 30 days prior to the completion of any milestone to arrange for the NASA Technical Contact or designee to witness the event or accept delivery of documents. NASA shall have 30 working days to determine whether the milestone event meets its corresponding acceptance criteria as

described in Appendix 2 of this Agreement and shall notify ORBITAL of NASA's acceptance or non-acceptance. Disagreement about the successful accomplishment of a milestone shall be deemed a Dispute and resolved in accordance with Article 19 of this Agreement.

(2) ORBITAL shall be able to submit an invoice requesting payment upon the accomplishment and acceptance by NASA of the milestone as identified and described in Appendix 2 of this Agreement. ORBITAL shall submit an original and one (1) copy of all invoices to the NASA Administrative Contact listed in this Agreement for review. After receipt and review of the invoice, the NASA Administrative Contact will prepare a written determination of milestone completion and authorize payment. Subject to change only through written Agreement modification, payment shall be made via electronic funds transfer to the address set forth below:

Bank Name:
Account Name:
Account Number:
ABA Number:



(3) The following information shall be included on each invoice:

(a) Agreement Number
(b) Invoice Number
(c) Description of milestone event
(d) Terms of Payment
(e) Payment Office
(f) Amount of the fixed contribution claimed

(4) Financial Records and Reports: Except as otherwise provided in this Agreement, ORBITAL's relevant financial records associated with this Agreement are not subject to examination or audit by NASA.

(5) Comptroller General Access to Records: The Comptroller General, at its discretion and pursuant to applicable laws and policies, shall have access to and the right to examine records of any Party to the Agreement or any entity that participates in the performance of this Agreement that directly pertain to and involve transactions relating to the Agreement for a period of three (3) years after the Government makes the final payment under this Agreement. This paragraph only applies to any record that is created or maintained in the ordinary course of business or pursuant to a provision of law. The terms of this paragraph shall be included in arrangements in excess of $5,000,000.00, which ORBITAL has entered into for the execution of the milestone events in this Agreement.

ARTICLE 6. DISSEMINATION OF PUBLIC INFORMATION

A. NASA or ORBITAL may, consistent with Federal law and this Agreement, release general information regarding its participation in this Agreement as desired. ORBITAL agrees that all press releases resulting from activities conducted under this

Agreement will be reviewed and concurred on by the NASA JSC Director of Public Affairs prior to release. Such approval will not be unreasonably withheld or delayed.

B. ORBITAL agrees the words "National Aeronautics and Space Administration" or the letters "NASA" will not be used in connection with a product or service in a manner reasonably calculated to convey any impression that such product or service has the authorization, support, sponsorship, or endorsement of NASA, which does not, in fact, exist. In addition, ORBITAL agrees that any proposed use of the NASA name or initials shall be submitted by ORBITAL in advance to the NASA Administrative Contact, who will submit the proposed use to the JSC Director of Public Affairs for review and approval. Such approval shall not be unreasonably withheld or delayed. Use of NASA emblems/devices (i.e., NASA Seal, NASA Insignia, NASA logotype, NASA Program Identifiers, and the NASA Flag) is governed by 14 C.F.R. Part 1221. ORBITAL agrees that any proposed use of such emblems/devices shall be submitted in advance to the NASA Administrative Contact, who will submit the proposed use to the NASA JSC Director of Public Affairs for review and approval in accordance with such regulations.

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

ARTICLE 7. NASA FURNISHED INFORMATION AND SERVICES

A. NASA may, at its sole discretion and on terms to be negotiated between the Parties, provide ORBITAL additional NASA services, technical expertise, or Government Property. Additional NASA services, technical expertise, or Government Property may be provided on either a reimbursable or non-reimbursable basis.

B. There is no Government Furnished Property or Services furnished under this Agreement except for those that may be provided in Article 7.A. However, ORBITAL has the ability to enter into separate Space Act agreements with NASA Centers to use NASA resources in performance of this Agreement. The terms and conditions of other Space Act agreements will govern the use of NASA resources not being provided under this Agreement. Orbital will be responsible for ensuring timely, accurate work of its team, including any NASA Centers, and, if necessary, replacing such subcontractors/partners in order to meet milestones.

ARTICLE 8. NONEXCLUSIVITY

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

ARTICLE 9: PARTICIPANT ANNUAL CERTIFICATIONS

ORBITAL shall annually certify the following to the COTS Administrative Contact:

A. ORBITAL is not, nor are any of its subcontractors/partners presently debarred, suspended, proposed for debarment, or otherwise declared ineligible for award of funding by any Federal agency.

B. ORBITAL has not, nor has any of its subcontractors/partners been convicted or had a civil judgment rendered against it within the last three (3) years for fraud in obtaining, attempting to obtain, or performing a Government contract.

C. ORBITAL and/or any of its subcontractors/partners receiving $100,000 or more in NASA funding for work performed under this Agreement must certify that they have not used any appropriated funds for lobbying purposes prohibited by 31 U.S.C. 1352.

D. ORBITAL is an eligible participant as defined in Section 4.2 of the COTS announcement.

ARTICLE 10. LIABILITY AND RISK OF LOSS

A. FAA license(s) or permit(s), including cross-waivers and insurance requirements, for COTS demonstrations conducted by ORBITAL under this Agreement shall govern the allocation of risks and liability, if any, of the U.S. Government – including NASA – and ORBITAL. To the extent the FAA license(s) or permit(s) do not apply to activities under this Agreement, the following cross-waiver will apply. Under no circumstances will NASA be liable for indemnification of third-party claims:

(1) Purpose: The objective of this Article is to establish a cross-waiver of liability by the Parties and their related entities in the interest of encouraging participation in the exploration, exploitation, and use of outer space through the COTS Demonstrations.

(2) For the purposes of this Article:

(a) The term "Partner State" includes each contracting party for which the Agreement Among The Government of Canada, Governments of Member States of the European Space Agency, the Government of Japan, the Government of the Russian Federation, and the Government of the United States of America Concerning Cooperation on the Civil International Space Station (ISS) (signed January 29, 1998; hereinafter the "Intergovernmental Agreement") has entered into force or become operative (pursuant to Sections 25 and 26, respectively, of the Intergovernmental Agreement), or any successor agreement. A Partner State includes its Cooperating Agency. It also includes any entity specified in the MOU between NASA and the Government of Japan to assist the Government of Japan's Cooperating Agency in the implementation of that MOU.

(b) The term "related entity" means:

(i) a contractor or subcontractor of a Party or a Partner State at any tier;

(ii) a user or customer of a Party or a Partner State at any tier; or

(iii) a contractor or subcontractor of a user or customer of a Party or a Partner State at any tier.

(c) The term "damage" means:

(i) bodily injury to, or other impairment of health of, or death of, any person;

(ii) damage to, loss of, or loss of use of any property;

(iii) loss of revenue or profits; or

(iv) other direct, indirect or consequential damage.

(d) The term "launch vehicle" means an object or any part thereof intended for launch, launched from Earth, or returning to Earth which carries payloads or persons, or both.

(e) The term "Party" means a Party to this agreement.

(f) The term "payload" means all property to be flown or used on or in a launch vehicle or the ISS.

(g) The term "Protected Space Operations" means all launch vehicle activities, ISS activities, and payload activities on Earth, in outer space, or in transit between Earth and outer space in implementation of the IGA, MOUs concluded pursuant to the IGA, and implementing arrangements. It includes, but is not limited to:

(i) research, design, development, test, manufacture, assembly, integration, operation, or use of launch or transfer vehicles, the ISS, or a payload, as well as related support equipment and facilities and services; and

(ii) all activities related to ground support, test, training, simulation, or guidance and control equipment and related facilities or services.

"Protected Space Operations" also includes all activities related to evolution of the ISS, as provided for in Article 14 of the IGA. "Protected Space Operations" excludes activities on Earth which are conducted on return from the ISS to develop further a payload's product or process for use other than for ISS related activities in implementation of the IGA.

(3) Cross Waiver of Liability

(a) Each Party agrees to a cross-waiver of liability pursuant to which each Party waives all claims against any of the entities or persons listed in subsections (3)(a)(i) through (3)(a)(iv) below based on damage arising out of Protected Space Operations. This cross-waiver shall apply only if the person, entity, or property causing the damage is involved in Protected Space Operations and the person, entity, or property damaged is damaged by virtue of its involvement in Protected Space Operations. The cross-waiver shall apply to any claims for damage, whatever the legal basis for such claims against:

(i) another Party;

(ii) a Partner State other than the United States of America;

(iii) a related entity of any entity identified in subparagraphs (3)(a)(i) or (3)(a)(ii) above;

(iv) the employees of any of the entities identified in subsections (3)(a)(i) through (3)(a)(iii) above.

(b) In addition, each Party shall, by contract or otherwise, extend the cross-waiver of liability as set forth in subsection (3)(a) above to its related entities by requiring them to:

(i) waive all claims against the entities or persons identified in subsections (3)(a)(i) through (3)(a)(iv) above; and

(ii) require that their related entities waive all claims against the entities or persons identified in subsections (3)(a)(i) through (3)(a)(iv) above.

(c) For avoidance of doubt, this cross-waiver of liability includes a cross-waiver of liability arising from the Convention on International Liability for Damage Caused by Space Objects (which entered into force on September 1, 1972), where the person, entity, or property causing the damage is involved in Protected Space Operations and the person, entity, or property damaged is damaged by virtue of its involvement in Protected Space Operations.

(d) Notwithstanding the other provisions of this section, this cross-waiver of liability shall not be applicable to:

(i) claims between a Party and its related entities or between its related entities;

(ii) claims made by a natural person, his/her estate, survivors or subrogees (except when a subrogee is a Party to this Agreement or is otherwise bound by the terms of this cross-waiver) for bodily injury to, or other impairment of health of, or death of such natural person;

(iii) claims for damage caused by willful misconduct;

(iv) intellectual property claims;

(v) claims for damage resulting from a failure of a Party to extend the cross-waiver of liability to its related entities, pursuant to subsection (c)(2) above;

(vi) claims by or against a Party arising out of the other Party's failure to meet its contractual obligations as set forth in the Agreement.

(e) Nothing in this section shall be construed to create the basis for a claim or suit where none would otherwise exist.

(f) This cross-waiver shall not be applicable when the Commercial Space Launch Act cross-waiver (49 U.S.C. 70101 *et seq*) is applicable.

B. Government Provided Property

For all property provided by NASA to ORBITAL under this Agreement, including property provided on a reimbursable or non-reimbursable basis, the following provisions apply:

1. ORBITAL 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, ORBITAL employees or the employees of ORBITAL's related entities, or for damage to, or loss of, ORBITAL 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.

2. ORBITAL 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 11. LIMITATION ON PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS

ORBITAL shall not use any funds provided under this Agreement to pay any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with any of the following covered Federal actions: the awarding of any Federal contract; the making of any Federal grant; the making of any Federal loan; the entering into of any cooperative agreement; or the modification of any Federal contract, grant, loan, or cooperative agreement.

ARTICLE 12. INTELLECTUAL PROPERTY AND DATA RIGHTS - RIGHTS IN DATA

A. General

(1) "Related Entity" as used in this Article, means a contractor, subcontractor, grantee, or other entity having a legal relationship with NASA or ORBITAL that is assigned, tasked, or contracted with to perform specified NASA or ORBITAL activities under this Agreement.

(2) "Data," as used in this Agreement, means recorded information, regardless of form, the media on which it may be recorded, or the method of recording. The term includes, but is not limited to, data of a scientific or technical nature, software and documentation thereof, and data comprising commercial and financial information.

(3) "Proprietary Data," as used in this Article, means Data embodying trade secrets or comprising commercial or financial information that is privileged or confidential.

(4) The Data rights set forth herein are applicable to employees of ORBITAL and employees of any Related Entity of ORBITAL. ORBITAL shall ensure that its employees and employees of any Related Entity that perform ORBITAL activities under this Agreement are aware of the obligations under this Article and that all such employees are bound to such obligations.

(5) Data exchanged between NASA and ORBITAL under this Agreement will be exchanged without restriction as to its disclosure, use, or duplication except as otherwise provided in this Article.

(6) No preexisting Proprietary Data will be exchanged between the Parties under this Agreement unless specifically authorized in this Article or in writing by the owner of the Proprietary Data.

(7) Certain Data exchanged by the Parties may be deemed by a Party to be privileged, confidential, or otherwise not subject to further dissemination, which Data must be clearly marked with a restrictive notice. In the event that Data exchanged between NASA and ORBITAL include a restrictive notice that NASA or ORBITAL deems to be ambiguous or unauthorized, NASA or ORBITAL may inform the other party of such condition. Notwithstanding such a notice, as long as such notice provides an indication that a restriction on use or disclosure was intended, the Party receiving such

Data will treat the Data pursuant to the requirements of this clause unless otherwise directed in writing by the Party providing such Data.

(8) Notwithstanding any restriction on use, disclosure, or reproduction of Data provided in this clause, the Parties will not be restricted in the use, disclosure, or reproduction of Data provided under this Agreement that: (a) is publicly available at the time of disclosure or thereafter becomes publicly available without breach of this Agreement; (b) is known to, in the possession of, or developed by the receiving Party independent of carrying out the receiving Party's responsibilities under this Agreement and independent of any disclosure of, or without reference to, Proprietary Data or otherwise protectable Data hereunder; (c) is received from a third party having the right to disclose such information without restriction; or (d) is required to be produced by the receiving Party pursuant to a court order or other legal requirement.

(9) If either NASA or ORBITAL believes that any of the events or conditions that remove restriction on the use, disclosure, or reproduction of the Data apply, NASA or ORBITAL will promptly notify the other Party of such belief prior to acting on such belief, and, in any event, will notify the other Party prior to an unrestricted use, disclosure, or reproduction of such Data.

(10) Disclaimer of Liability: Notwithstanding any restriction on use, disclosure, or reproduction of Data provided in this Article, NASA will not be restricted in, nor incur any liability for, the use, disclosure, or reproduction of any Data not identified with a suitable restrictive notice in accordance with paragraphs B and G of this Article or of any Data included in Data which ORBITAL has furnished, or is required to furnish to the U.S. Government without restriction on disclosure and use.

(11) When disclosing Data to NASA, ORBITAL may use the following, or a similar, restrictive notice as required by paragraphs B and G of this Article. In addition to identifying Proprietary Data with such a restrictive notice, ORBITAL shall mark each page containing Proprietary Data with the following, or a similar, legend: "PROPRIETARY DATA – use and disclose only in accordance with notice on title or cover page."

Proprietary Data Notice

These data herein include <*enter as applicable*: "Background Data" or "Data Produced by Participant under a Space Act Agreement"> in accordance with the Data Rights provisions under Space Act Agreement <*provide applicable identifying information*> and embody Proprietary Data. In accordance with the Space Act Agreement, NASA will use reasonable efforts to maintain the data in confidence and limit use, disclosure, and reproduction by NASA and any Related Entity of NASA (under suitable protective conditions) in accordance with restrictions identified in the Space Act Agreement <*may list specific restrictions listed in the Agreement*>.

B. Data First Produced by ORBITAL under this Agreement

(1) Data first produced by ORBITAL in carrying out ORBITAL's responsibilities under this Agreement, including but not limited to technical data related to inventions made under this Agreement, will be furnished to NASA upon request and such Data will be disclosed and used by NASA and any Related Entity of NASA (under suitable protective conditions) during the term of this Agreement only for evaluating ORBITAL's performance under this Agreement. If ORBITAL considers any such Data to be Proprietary Data, and such Data is identified with a suitable restrictive notice, NASA will use reasonable efforts to maintain the Data in confidence.

(2) Upon a successful completion by ORBITAL of all milestones under this Agreement, NASA shall not assert rights in such Data or use such Data for any purpose except that NASA shall retain the right to: (1) maintain a copy of such Data for archival purposes; and (2) use or disclose such archived Data by or on behalf of NASA for Government purposes, but only in the event the NASA determines that:

(a) Such action is necessary because ORBITAL, its assignee, or other successor has not taken, or is not expected to take within a reasonable time, effective steps to achieve practical application of inventions or software related to such Data;

(b) Such action is necessary because ORBITAL, its assignee, or other successor, having achieved practical application of inventions or software related to such Data, has failed to maintain practical application of such inventions;

(c) Such action is necessary because ORBITAL, its assignee, or other successor has discontinued making the benefits of inventions or software related to such Data available to the public or to the Federal Government;

(d) Such action is necessary to alleviate health or safety needs which are not reasonably satisfied by ORBITAL, its assignee, or other successor; or

(e) Such action is necessary to meet requirements for public use specified by Federal regulations and such requirements are not reasonably satisfied by ORBITAL, its assignee, or successor.

(3) In the event NASA terminates this Agreement in accordance with Article 17.B., Termination for Failure to Perform, NASA shall have the right to use or disclose Data first produced by ORBITAL in carrying out ORBITAL's responsibilities under this Agreement by or on behalf of NASA for Government purposes. The Parties will negotiate rights in Data in the event of termination for any other reason in accordance with Article 17.

C. Data First Produced by NASA under this Agreement

(1) As to Data first produced by NASA (or any Related Entity of NASA) in carrying out NASA responsibilities under this Agreement that would be Proprietary Data if it had been obtained from ORBITAL, such Data will be appropriately marked with a restrictive notice and maintained in confidence for the duration of this Agreement, with the express understanding that during the aforesaid restricted period such Data may be disclosed and used by NASA and any Related Entity of NASA (under suitable protective conditions) only for carrying out NASA responsibilities under this Agreement.

(2) Upon a successful completion by ORBITAL of all milestones under this Agreement, NASA shall not use such Data for any purpose except that NASA shall retain the right to: (1) maintain a copy of such Data for archival purposes; and (2) use or

disclose such archived Data by or behalf of the NASA for Government purposes in the event the NASA determines that:

(a) Such action is necessary because ORBITAL, its assignee, or other successor has not taken, or is not expected to take within a reasonable time, effective steps to achieve practical application of inventions or software related to such Data;

(b) Such action is necessary because ORBITAL, its assignee, or other successor, having achieved practical application of inventions or software related to such Data, has failed to maintain practical application of such inventions;

(c) Such action is necessary because ORBITAL, its assignee, or other successor has discontinued making the benefits of inventions or software related to such Data available to the public or to the Federal Government;

(d) Such action is necessary to alleviate health or safety needs which are not reasonably satisfied by ORBITAL, its assignee, or other successor; or

(e) Such action is necessary to meet requirements for public use specified by Federal regulations and such requirements are not reasonably satisfied by ORBITAL, its assignee, or successor.

(3) In the event NASA terminates this Agreement in accordance with Article 17.B., Termination for Failure to Perform, NASA shall have the right to use or disclose Data first produced by NASA in carrying out NASA's responsibilities under this Agreement by or on behalf of NASA for Government purposes.

(4) The parties will negotiate rights in Data in the event of termination for any other reason.

D. Publication of Results

(1) Recognizing that section 203 of the National Aeronautics and Space Act of 1958 (42 U.S.C. § 2473), as amended, requires NASA to provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof, and that the dissemination of the results of NASA activities is one of the considerations for this Agreement, NASA will coordinate proposed publication of results with ORBITAL in a manner that allows ORBITAL a reasonable amount of time to review and comment on proposed publications.

(2) Consistent with other obligations in this Article, NASA agrees that it will not publish any results without first receiving permission from ORBITAL.

E. Data Disclosing an Invention

In the event Data exchanged between NASA and ORBITAL discloses an invention for which patent protection is being considered, the furnishing Party specifically identifies such Data to the receiving Party, and the disclosure and use of such Data is not otherwise limited or restricted herein, the receiving Party agrees to withhold such Data from public disclosure for a reasonable time (presumed to be 1 year unless mutually agreed otherwise) in order for patent protection to be obtained.

F. Data Subject to Export Control

Technical data, whether or not specifically identified or marked, that is subject to the export laws and regulations of the United States and that is provided to or from ORBITAL under this Agreement will be treated as such, and will not be further provided

to any foreign persons or transmitted outside the United States without proper U.S. Government authorization, where required.

G. Background Data

(1) In the event ORBITAL furnishes NASA with Data developed at private expense that existed prior to, or was produced outside of, this Agreement, and such Data embody Proprietary Data, and such Data is so identified with a suitable restrictive notice, NASA will use reasonable efforts to maintain the Data in confidence. NASA shall have no rights to use such data, except such Data may be disclosed and used by NASA and any Related Entity of NASA (under suitable protective conditions) only for evaluating ORBITAL's performance under this Agreement. Upon completion of activities under this Agreement, such Data will be disposed of as requested by ORBITAL.

(2) At the time of execution of this Agreement, the Parties agree that the following Background Data embodies Proprietary Data that will be provided to NASA:

(a) Taurus II Design and Development Data

H. Handling of Data

(1) In the performance of this Agreement, ORBITAL and any Related Entity of ORBITAL may have access to, be furnished with, or use the following categories of Data:

(a) Proprietary Data of third parties that the U.S. Government has agreed to handle under protective arrangements; and/or

(b) U.S. Government Data, the use and dissemination of which, the U.S. Government intends to control.

(2) Data provided by the U.S. Government under the Agreement

(a) The Parties agree that the following Proprietary Data of third parties will be provided to ORBITAL with the express understanding that ORBITAL will use and protect such Data in accordance with this Article:

Note: From time-to-time during the term of this Agreement, Orbital may request from NASA, and NASA may provide such Proprietary Data of third parties.

(b) The Parties agree that the following U.S. Government Data will be provided to ORBITAL with the express understanding that ORBITAL will use and protect such U.S. Government Data in accordance with this Article:

Note: From time-to-time during the term of this Agreement, Orbital may request from NASA, and NASA may provide such U.S. Government Data.

(c) The Parties agree that the following software and related Data will be provided to ORBITAL under a separate Software Usage Agreement with the express understanding that ORBITAL will use and protect such related Data in accordance with this Article. Unless ORBITAL has entered into a license, consistent with 37 C.F.R. Part

404, for software provided under this Agreement, upon completion of activities under this Agreement, such related Data will be disposed of as instructed by NASA:

Note: From time-to-time during the term of this Agreement, Orbital may request from NASA, and NASA may provide such software and related Data.

(3) With respect to such Data specifically identified in this Agreement or specifically marked with a restrictive notice, ORBITAL agrees to:

(a) Use, disclose, or reproduce such Data only to the extent necessary to perform the work required under this Agreement;

(b) Safeguard such Data from unauthorized use and disclosure;

(c) Allow access to such Data only to its employees and any Related Entity that require access for their performance under this Agreement;

(d) Except as otherwise indicated in (3)(c) above, preclude access and disclosure of such Data outside ORBITAL's organization;

(e) Notify its employees who may require access to such Data about the obligations under this Article, obtain written affirmation from all such employees that they have received such notification, administer a monitoring process to ensure that such employees comply with such obligations, and ensure that any Related Entity performs the same functions with respect to its employees; and

(f) Return or dispose of such Data, as NASA may direct, when the Data is no longer needed for performance under this Agreement.

I. Oral and visual information

If information that ORBITAL considers to be Proprietary Data is disclosed orally or visually to NASA, NASA will have no duty to limit or restrict, and will not incur any liability for, any disclosure or use of such information unless (1) ORBITAL orally informs NASA before initial disclosure that such information is considered to be Proprietary Data, and (2) ORBITAL reduces such information to tangible, recorded form that is identified and marked with a suitable restrictive notice as required by paragraphs B and G above and furnishes the resulting Data to NASA within 10 days after such oral or visual disclosure.

ARTICLE 13. INTELLECTUAL PROPERTY AND DATA RIGHTS - INVENTION AND PATENT RIGHTS

NASA obtains no right in pre-existing Inventions, except for Inventions made under this Agreement.

A. Definitions

(1) "Administrator," as used in this Article, means the Administrator of the National Aeronautics and Space Administration (NASA) or duly authorized representative.

(2) "Patent Representative" as used in this Article means the NASA Johnson Space Center Patent Counsel. Correspondence with the Patent Representative under this clause will be sent to the address below:

Patent Counsel
NASA Johnson Space Center
Mail Code AL
2101 NASA Parkway
Houston, TX 77058

(3) "Invention," as used in this Agreement, means any innovation or discovery that is or may be patentable or otherwise protectable under title 35 of the U.S.C.

(4) "Made," as used in relation to any invention, means the conception or first actual reduction to practice of such invention.

(5) "Practical application," as used in this Agreement, means to manufacture, in the case of a composition or product; to practice, in the case of a process or method; or to operate, in case of a machine or system; and, in each case, under such conditions as to establish that the invention, software, or related Data is being utilized and that its benefits are, to the extent permitted by law or Government regulations, available to the public or to the Federal Government on reasonable terms.

(6) "Related Entity" as used in this Article, means a contractor, subcontractor, grantee, or other entity having a legal relationship with NASA or ORBITAL that is assigned, tasked, or contracted with to perform specified NASA or ORBITAL activities under this Agreement.

B. Allocation of principal rights

(1) Presumption of title

(a) Any invention made under this Agreement shall be presumed to have been made in the manner specified in paragraph (1) or (2) of section 305(a) (42 U.S.C. § 2457(a)) of the National Aeronautics and Space Act of 1958 (hereinafter called "the Act"), and the above presumption shall be conclusive unless at the time of reporting such invention ORBITAL submits to the Patent Representative a written statement, containing supporting details, demonstrating that the invention was not made in the manner specified in paragraph (1) or (2) of section 305(a) of the Act. For the avoidance of doubt, any inventions made in the development of Taurus II shall not be considered inventions made under this Agreement.

(b) Regardless of whether title to such an invention would otherwise be subject to an advance waiver or is the subject of a petition for waiver as described in paragraph B.(3) and paragraph I, ORBITAL may nevertheless file the statement described in paragraph B.(1)(a) of this Article. The Administrator (or his designee) will review the information furnished by ORBITAL in any such statement and any other available information relating to the circumstances surrounding the making of the invention and will notify ORBITAL whether the Administrator has determined that the invention was made in the manner specified in paragraph (1) or (2) of section 305(a) of the Act.

(2) Property rights in inventions. Each invention made under this Agreement for which the presumption of paragraph B.(1)(a) of this clause is conclusive or for which there has been a determination that it was made in the manner specified in paragraph (1) or (2) of section 305(a) of the Act shall be the exclusive property of the United States as represented by the Administrator of NASA unless the Administrator waives all or any

part of the rights of the United States to ORBITAL's invention, as provided in paragraph B.(3) of this clause.

(3) Waiver of rights.

(a) The NASA Patent Waiver Regulations, 14 C.F.R. Part 1245, Subpart 1, have adopted the Presidential Memorandum on Government Patent Policy of February 18, 1983, as a guide in acting on petitions (requests) for waiver of rights to any invention or class of inventions made or that may be made in the manner specified in paragraph (1) or (2) of Section 305(a) of the Act.

(b) NASA has determined that to stimulate and support the capability of a United States commercial provider to provide space and orbital transportation services to the public and the Federal Government, the interest of the United States would be served by waiving to ORBITAL, in accordance with provisions of 14 C.F.R. Part 1245, Subpart 1, rights to inventions made by ORBITAL in the performance of work under this Agreement. Therefore, upon petition submitted by ORBITAL, as provided in 14 C.F.R. Part 1245, Subpart 1, either prior to execution of the Agreement or within 30 days after execution of the Agreement, for advance waiver of rights to any or all of the inventions that may be made under this Agreement, NASA will waive such rights to ORBITAL. If such a petition is not submitted, ORBITAL may petition for waiver of rights to an identified invention within eight months of first disclosure of invention in accordance with paragraph E.(2) of this clause or within such longer period as may be authorized in accordance with 14 CFR 1245.105. Further procedures are provided in paragraph I of this clause.

C. Minimum rights reserved by the Government

(1) With respect to each ORBITAL invention made under this Agreement for which a waiver of rights is applicable in accordance with 14 C.F.R. Part 1245, Subpart 1, the Government reserves:

(a) An irrevocable, royalty-free license for the practice of such invention throughout the world by or on behalf of the United States or any foreign government in accordance with any treaty or agreement with the United States; and

(b) Such other March-in rights as given in Paragraph H below.

(2) NASA will not exercise the government purpose license reserved in paragraph C.(1)(a) during the term of this Agreement.

(3) Upon a successful completion by ORBITAL of all milestones under this Agreement, NASA will refrain from exercising the government purpose license reserved in paragraph C.(1)(a) for a period of five (5) years following the expiration of this Agreement or until December 31, 2015, whichever is later.

(4) Nothing contained in this paragraph shall be considered to grant to the Government any rights with respect to any invention other than an invention made under this Agreement.

D. Minimum rights to ORBITAL

(1) ORBITAL is hereby granted a revocable, nonexclusive, royalty-free license in each patent application filed in any country on an invention made by ORBITAL under this Agreement and any resulting patent in which the Government acquires title, unless ORBITAL fails to disclose such invention within the times specified in paragraph E.(2)

of this clause. ORBITAL's license extends to its domestic subsidiaries and affiliates, if any, within the corporate structure of which ORBITAL is a party and includes the right to grant sublicenses of the same scope to the extent ORBITAL was legally obligated to do so at the time the Agreement was awarded. The license is transferable only with the approval of the Administrator except when transferred to the successor of that part of ORBITAL's business to which the invention pertains.

(2) ORBITAL's domestic license may be revoked or modified by the Administrator to the extent necessary to achieve expeditious practical application of such invention pursuant to an application for an exclusive license submitted in accordance with 37 C.F.R. Part 404, Licensing of Government Owned Inventions. This license will not be revoked in that field of use or the geographical areas in which ORBITAL has achieved practical application and continues to make the benefits of the invention reasonably accessible to the public. The license in any foreign country may be revoked or modified at the discretion of the Administrator to the extent ORBITAL, its licensees, or its domestic subsidiaries or affiliates have failed to achieve practical application in that foreign country.

(3) Before revocation or modification of the license, ORBITAL will be provided a written notice of the Administrator's intention to revoke or modify the license, and ORBITAL will be allowed 30 days (or such other time as may be authorized by the Administrator for good cause shown by ORBITAL) after the notice to show cause why the license should not be revoked or modified. ORBITAL has the right to appeal, in accordance with 14 C.F.R. 1245.112, any decision concerning the revocation or modification of its license.

E. Invention identification, disclosures, and reports

(1) ORBITAL shall establish and maintain active and effective procedures to assure that inventions made under this Agreement are promptly identified and disclosed to ORBITAL personnel responsible for the administration of this clause within six months of conception and/or first actual reduction to practice, whichever occurs first in the performance of work under this Agreement. These procedures shall include the maintenance of laboratory notebooks or equivalent records and other records as are reasonably necessary to document the conception and/or the first actual reduction to practice of such inventions, and records that show that the procedures for identifying and disclosing such inventions are followed. Upon request, ORBITAL shall furnish the Patent Representative a description of such procedures for evaluation and for determination as to their effectiveness.

(2) ORBITAL will disclose each such invention to the Patent Representative within two months after the inventor discloses it in writing to ORBITAL personnel responsible for the administration of this clause or, if earlier, within six months after ORBITAL becomes aware that such an invention has been made, but in any event before any on sale, public use, or publication of such invention known to ORBITAL. ORBITAL shall use the NASA electronic New Technology Reporting system (eNTRe), accessible at http://invention.nasa.gov, to disclose inventions. The invention disclosure shall identify this Agreement and shall be sufficiently complete in technical detail to convey a clear understanding, to the extent known at the time of the disclosure, of the nature, purpose, operation, and physical, chemical, biological, or electrical characteristics of the invention.

The disclosure shall also identify any publication, on sale, or public use of any such invention and whether a manuscript describing such invention has been submitted for publication and, if so, whether it has been accepted for publication at the time of disclosure. In addition, after disclosure to NASA, ORBITAL will promptly notify NASA of the acceptance of any manuscript describing such an invention for publication or of any on sale or public use planned by ORBITAL for such invention.

(3) ORBITAL shall furnish the Patent Representative the following:

(a) Interim reports every 12 months (or such longer period as may be specified by the Patent Representative) from the date of the Agreement, listing inventions made under this Agreement during that period, and certifying that all such inventions have been disclosed (or that there are no such inventions) and that the procedures required by paragraph E.(2) of this clause have been followed.

(b) A final report, within three months after completion of the work, listing all inventions made under this Agreement or certifying that there were no such inventions, and listing all subcontracts or other agreements with a Related Entity containing a patent and invention rights clause (as required under paragraph G of this clause) or certifying that there were no such subcontracts or other agreements.

(c) Interim and final reports shall be submitted electronically at the eNTRe Web-site http://invention.nasa.gov.

(4) ORBITAL agrees, upon written request of the Patent Representative, to furnish additional technical and other information available to ORBITAL as is necessary for the preparation of a patent application on an invention made under this Agreement in which the Government retains title and for the prosecution of the patent application, and to execute all papers necessary to file patent applications on such inventions and to establish the Government's rights in the inventions.

(5) Protection of reported inventions. When inventions made under this Agreement are reported and disclosed to NASA in accordance with the provisions of this Article, NASA agrees to withhold such reports or disclosures from public access for a reasonable time (presumed to be 1 year unless otherwise mutually agreed) in order to facilitate the allocation and establishment of the invention and patent rights under these provisions.

F. Examination of records relating to inventions

(1) The Patent Representative or designee shall have the right to examine any books (including laboratory notebooks), records, and documents of ORBITAL relating to the conception or first actual reduction to practice of inventions in the same field of technology as the work under this Agreement to determine whether

(a) Any such inventions were made in performance of this Agreement;

(b) ORBITAL has established and maintained the procedures required by paragraph E.(1) of this clause; and

(c) ORBITAL and its inventors have complied with the procedures.

(2) If the Patent Representative learns of an unreported ORBITAL invention that the Patent Representative believes may have been made under this Agreement, ORBITAL may be required to disclose the invention to NASA for a determination of ownership rights.

(3) Any examination of records under this paragraph will be subject to appropriate conditions to protect the confidentiality of the information involved.

G. Subcontracts or Other Agreements

(1)(a) Unless otherwise authorized or directed by the Patent Representative, ORBITAL shall include this *Invention and Patent Rights* Article (suitably modified to identify the parties) in any subcontract or other agreement with a Related Entity hereunder (regardless of tier) for the performance of experimental, developmental, or research work.

(b) In the *Invention and Patent Rights* Article included in any such subcontract or other agreement, the following (suitably modified to identify the parties) shall be substituted for paragraph B(3)(b):

> As provided in 14 C.F.R. Part 1245, Subpart 1, ORBITAL may petition, either prior to execution of the Agreement or within 30 days after execution of the Agreement, for advance waiver of rights to any or all of the inventions that may be made under this Agreement. If such a petition is not submitted, or if after submission it is denied, ORBITAL may petition for waiver of rights to an identified invention within eight months of first disclosure of invention in accordance with paragraph E.(2) of this Article or within such longer period as may be authorized in accordance with 14 CFR 1245.105. Further procedures are provided in paragraph H of this Article.

(c) In the case of subcontracts or other agreements at any tier, NASA, the Related Entity, and ORBITAL agree that the mutual obligations of the parties created by this Article constitute privity of contract between the Related Entity and NASA with respect to those matters covered by this Article.

(2) In the event of a refusal by a prospective Related Entity to accept such a clause, ORBITAL:

(a) Shall promptly submit a written notice to the Patent Representative setting forth the prospective Related Entity's reasons for such refusal and other pertinent information that may expedite disposition of the matter; and

(b) Shall not proceed with such subcontract or other agreement without the written authorization of the Patent Representative.

(3) ORBITAL shall promptly notify the Patent Representative in writing upon the award of any subcontract or other agreement with a Related Entity (at any tier) containing an invention and patent rights clause by identifying the Related Entity, the applicable invention and patent rights clause, the work to be performed under the subcontract or other agreement, and the dates of award and estimated completion. Upon request of the Patent Representative, ORBITAL shall furnish a copy of such subcontract or other agreement, and, no more frequently than annually, a listing of the subcontracts or other agreements that have been awarded.

(4) In recognition of ORBITAL's substantial contribution of funds, facilities and/or equipment to the work performed under this Agreement, ORBITAL is authorized, subject to the rights of NASA set forth elsewhere in this Article, to:

(a) Acquire by negotiation and mutual agreement rights to an invention made under this Agreement by a Related Entity as ORBITAL may deem necessary to obtaining and maintaining of private support; and

(b) Request, in the event of inability to reach agreement pursuant to paragraph 7(e)(i) of this Article, that NASA request that such rights for ORBITAL be included as an additional reservation in a waiver granted pursuant to 14 CFR Part 1245, Subpart 1. Any such requests to NASA should be prepared in consideration of the following guidance and submitted to the Patent Representative. Notwithstanding paragraph B.(3)(b) of this Article, the Related Entity should be advised that unless it requests a waiver of title pursuant to the NASA Patent Waiver Regulations (14 C.F.R. Part 1245, Subpart 1), NASA will acquire title to inventions made under this Agreement. If a waiver is not requested or granted, ORBITAL may request a license from NASA consistent with the requirements of 37 CFR Part 404. A Related Entity requesting a waiver must follow the procedures set forth in paragraph I of this Article.

H. March-in rights

(1) ORBITAL agrees that, with respect to any invention made under this Agreement in which it has acquired title, NASA has the right in accordance with the procedures in 37 CFR 401.6 and any supplemental regulations of the agency to require ORBITAL, or an assignee or exclusive licensee of such an invention, to grant a nonexclusive, partially exclusive, or exclusive license in any field of use to a responsible applicant or applicants, upon terms that are reasonable under the circumstances, and if ORBITAL, its assignee, or exclusive licensee refuses such a request NASA has the right to grant such a license itself if the Federal agency determines that:

(a) Such action is necessary because ORBITAL, assignee, or exclusive licensee has not taken, or is not expected to take within a reasonable time, effective steps to achieve practical application of such invention in such field of use;

(b) Such action is necessary because ORBITAL, assignee, or exclusive licensee, having achieved practical application of such invention, has failed to maintain practical application of such invention in such field of use;

(c) Such action is necessary because ORBITAL, assignee, or exclusive licensee has discontinued making the benefits of such invention available to the public or to the Federal Government;

(d) Such action is necessary to alleviate health or safety needs which are not reasonably satisfied by ORBITAL, assignee, or exclusive licensee; or

(e) Such action is necessary to meet requirements for public use specified by Federal regulations and such requirements are not reasonably satisfied by ORBITAL, assignee, or exclusive licensee.

I. Requests for Waiver of Rights

(1) In accordance with the NASA Patent Waiver Regulations, 14 C.F.R. Part 1245, Subpart 1, waiver of rights to any or all inventions made or that may be made under this Agreement may be requested at different time periods. Advance waiver of rights to any or all such inventions may be requested prior to the execution of the Agreement, or within 30 days after execution thereof. In addition, waiver of rights to an identified invention made and reported under this Agreement may be requested, even though a request for an advance waiver was not previously requested or, if previously requested, was not granted.

(2) Each request for waiver of rights shall be by petition to the Administrator and shall include an identification of the petitioner; place of business and address; if petitioner is represented by counsel, the name, address, and telephone number of the counsel; the signature of the petitioner or authorized representative; and the date of signature. No specific forms need be used, but the request should contain a positive statement that waiver of rights is being requested under the NASA Patent Waiver Regulations; a clear indication of whether the request is for an advance waiver or for a waiver of rights for an individual identified invention; whether foreign rights are also requested and, if so, for which countries, and a citation of the specific section(s) of the regulations under which such rights are requested; and the name, address, and telephone number of the party with whom to communicate when the request is acted upon.

(3) All petitions for waiver, whether advanced or individual petitions, will be submitted to the Patent Representative designated in this Article.

(4) A Petition submitted in advance of this Agreement will be forwarded by the Patent Representative to the Inventions and Contributions Board. The Board will consider the petition and where the Board makes the findings to support the waiver, the Board will recommend to the Administrator that waiver be granted, and will notify the petitioner and the Patent Representative of the Administrator's determination. The Patent Representative will be informed by the Board whenever there is insufficient time or information to permit a decision to be made on an advance waiver without unduly delaying the execution of the Agreement. In the event a request for an advanced waiver is not granted or is not decided upon before execution of the Agreement, the petitioner will be so notified by the Patent Representative. All other petitions will be processed by the Patent Representative and forwarded to the Board. The Board shall notify the petitioner of its action and if waiver is granted, the conditions, reservations, and obligations thereof will be included in the Instrument of Waiver. Whenever the Board notifies a petitioner of a recommendation adverse to, or different from, the waiver requested, the petitioner may request reconsideration under procedures set forth in the NASA Patent Waiver Regulations.

ARTICLE 14. RESERVED

ARTICLE 15. DISCLAIMER OF WARRANTY

Goods (i.e., equipment, facilities, technical information, data, prototypes) and services, if provided by NASA under this Agreement, are provided "as is" and no warranty related to availability, title, or suitability for any particular use, nor any implied warranty of merchantability or fitness for a particular purpose, is provided under this Agreement. NASA makes no express or implied warranty as to any intellectual property, generated information, or product made or developed under this Agreement, or that the goods, services, materials, products, processes, information, or data to be furnished hereunder will accomplish intended results or are safe for any purpose including the intended purpose. Neither NASA nor its contractors shall be liable for special, consequential, indirect, or incidental damages attributed to such goods, services, materials, products, processes, information, or data to be furnished under this Agreement.

ORBITAL has not made, nor does it make, any representation or warranty hereunder, whether written or oral, whether express or implied, including, but not limited to, any warranty as to any intellectual property, generated information, design, operation, quality, workmanship, suitability, result, merchantability, or fitness for a particular purpose with respect to the COTS Project, COTS Demonstrations, spacecraft, launch vehicles, launch services, or any associated equipment and services. Any implied warranties, including warranties of merchantability and fitness for a particular purpose, are hereby expressly disclaimed. ORBITAL makes no express or implied warranty that the goods, services, materials, products, processes, information, or data to be furnished hereunder will accomplish intended results or are safe for any purpose including the intended purpose. Neither ORBITAL nor its contractors shall be liable for special, consequential, indirect, or incidental damages attributed to such goods, services, materials, products, processes, information, or data to be furnished under this Agreement.

ARTICLE 16. TERM OF AGREEMENT

This Agreement becomes effective upon the date of the last signature below and shall remain in effect until the completion of all obligations of both Parties hereto, or five (5) years from the date of the last signature, whichever comes first.

ARTICLE 17. TERMINATION

A. Termination by Mutual Consent.
This Agreement may be terminated at any time upon mutual written consent of both parties.

B. Termination for Failure to Perform

(1) NASA may terminate this Agreement if ORBITAL has failed to perform under the Agreement including failure to meet a scheduled milestone as identified and described in Appendix 2. Before such a termination NASA will consult with ORBITAL to ascertain the cause of the failure and determine if additional efforts are in the best interests of the Parties and will provide ORBITAL 30 day written notice to cure or initiate an acceptable plan to cure the failure. Upon such a termination NASA will take all rights identified in Articles 12 and 13 of this agreement.

(2) ORBITAL will not be entitled to any additional payments from the Government due to a termination for failure to meet a milestone. NASA and ORBITAL will negotiate in good faith any other outstanding issues between the Parties. Failure of the Parties to agree will be resolved pursuant to Article 19, Dispute Resolution.

C. Unilateral Termination by NASA:

(1) NASA may unilaterally terminate this Agreement upon written notice under the following circumstances: (a) upon a declaration of war by the Congress of the United States; or (b) upon a declaration of a national emergency by the President of the United States; or (c) upon a NASA determination, in writing, that NASA is required to terminate for reasons beyond its control. For purposes of this Article, reasons beyond NASA's control include, but are not limited to, acts of God or of the public enemy, acts of the U.S. Government other than NASA, in either its sovereign or contractual capacity (to include

failure of Congress to appropriate sufficient funding), fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, or unusually severe weather.

(2) Upon receipt of written notification that the Government is unilaterally terminating this Agreement, ORBITAL shall immediately stop work under this Agreement and shall immediately cause any and all of its partners and suppliers to cease work, except to the extent that ORBITAL wishes to pursue these demonstrations exclusively using its own funding. Upon such a termination, NASA and ORBITAL agree to negotiate in good faith a final settlement payment to be made by NASA. However, in no instance shall NASA's liability for termination exceed the total amount due under the next milestone of this Agreement and is subject to the provisions of Article 5. Failure of the Parties to agree will be resolved pursuant to Article 19, Dispute Resolution.

D. Limitation on Damages.

In the event of any termination by NASA, neither NASA nor ORBITAL shall be liable for any loss of profits, revenue, or any indirect or consequential damages incurred by the other Party, its contractors, subcontractors, or customers as a result of any termination of this Agreement. A Party's liability for any damages under this Agreement is limited solely to direct damages, incurred by the other Party, as a result of any termination of this Agreement subject to mitigation of such damages by the complaining Party. However, in no instance shall NASA's liability for termination exceed the total amount due under the next milestone under this Agreement.

E. Rights in Property

ORBITAL will have title to property acquired or developed by ORBITAL and its contractors/partners with government funding, in whole or in part to conduct the work specified under this Agreement. In the event of termination of this Agreement for any reason, NASA may purchase such property as provided in Article 26 below. Upon any termination under this Article, NASA may immediately exercise all rights identified in Articles 12 and 13.

ARTICLE 18. CONTINUING OBLIGATIONS

The obligations of the Parties set forth in the provisions of Articles 10 (Liability and Risk of Loss) and 12-13 (Intellectual Property and Data Rights) of this Agreement concerning liability and intellectual property rights shall continue to apply after the expiration or termination of this Agreement.

ARTICLE 19. DISPUTE RESOLUTION

All disputes concerning questions of fact or law arising under this Agreement shall be referred by the claimant in writing to the ORBITAL Administrative Contact and the NASA Administrative Contact, who shall seek to resolve such disputes by negotiation and Mutual Agreement. If they are unable to resolve the dispute, then the dispute will be referred to the JSC Commercial Crew Cargo Project Manager and the ORBITAL Technical Contact for joint resolution. If the Parties are still unable to resolve the dispute, the Associate Administrator for Exploration Systems Mission Directorate, or the

Deputy of the Directorate, will seek to resolve the dispute with the ORBITAL Executive Vice-President and General Manager, APG. In the event that the preceding steps are unsuccessful and the Parties are unable to reach a mutually acceptable resolution, NASA shall issue a written decision that shall be a final Agency decision for all purposes including judicial review.

Pending resolution of any disputes pursuant to this Article, the Parties agree that performance of all obligations shall be pursued diligently in accordance with the direction of the JSC Commercial Crew Cargo Project Manager.

The Parties agree that this Disputes Resolution procedure shall be the exclusive procedure followed by the Parties in resolving any dispute arising under, or based on, an express or implied provision of this Agreement, including an alleged breach.

ARTICLE 20. PRINCIPAL POINTS OF CONTACT

The following personnel are designated as the Administrative and Technical Contacts between the Parties in the performance of this Agreement.

NASA Administrative Contact
Keith Hutto
Agreements Officer

Johnson Space Center
2101 NASA Parkway
Houston, TX 77058
Phone: 281-483-4165
Fax: 281-483-0503
E-mail: keith.d.hutto@nasa.gov

ORBITAL Administrative Contact

[redacted]

Orbital Sciences Corporation
21839 Atlantic Boulevard
Dulles, Virginia 20166
Phone: [redacted]
Fax: [redacted]

NASA Technical Contact
Alan J. Lindenmoyer
Program Manager
Johnson Space Center
Mail Stop: QA
2101 NASA Parkway
Houston, TX 77058
Phone: 281-244-7064
Fax: 281-483-5970
E-mail:alan.j.lindenmoyer@nasa.gov

ORBITAL Technical Contact

[redacted]

Orbital Sciences Corporation
21839 Atlantic Boulevard
Dulles, Virginia 20166

Phone: [redacted]
Fax: [redacted]

ARTICLE 21. MODIFICATION/AMENDMENTS

All modifications and amendments to this Agreement shall be by mutual agreement of the Parties and shall be executed, in writing, and signed by the signatories to this Agreement, or their respective successor or designee.

ARTICLE 22. ASSIGNMENT OF RIGHTS

Neither this Agreement nor any interest arising under it will be assigned by either Party without the express written consent of the other Party, which shall not unreasonably be withheld.

ARTICLE 23. ANTI-DEFICIENCY ACT

All activities under or pursuant to this Agreement are subject to the availability of appropriated funds, and no provision shall be interpreted to require obligation or provision of funds in violation of the Anti-Deficiency Act, 31 U.S.C. 1341.

ARTICLE 24. APPLICABLE LAW AND SEVERABILITY

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

If any portion of this Agreement is held invalid by a court of competent jurisdiction, the Parties agree that such invalidity shall not affect the validity of the remaining portions of this Agreement, unless applying such remaining portions would frustrate the purpose of this Agreement.

ARTICLE 25. EXPORT LICENSES

ORBITAL will be responsible for:

A. Compliance with all U.S. export control laws and regulations, including the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120 through 130, and the Export Administration Regulations (EAR), 15 CFR Parts 730 through 799, in the performance of this Agreement. In the absence of available license exemptions/exceptions, ORBITAL will 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.

B. Obtaining export licenses, if required, before utilizing foreign persons in the performance of this Agreement, including instances where COTS efforts are to be performed on-site at NASA Centers, where the foreign person will have access to export-controlled technical data or software.

C. All regulatory record keeping requirements associated with the use of licenses and license exemptions/exceptions.

D. Ensuring that the provisions of this Article apply to its subcontractors.

In the event that either Party intends to utilize a foreign person (as defined in the International Traffic in Arms Regulations and the Export Administration Regulations) in the performance of this Agreement, such Party shall be responsible for obtaining the required export licenses in advance of the foreign person's participation.

ARTICLE 26. TITLE AND RIGHTS IN PROPERTY

ORBITAL will have title to property acquired or developed under this Agreement, including developed or acquired by ORBITAL for COTS demonstrations. In the event of termination of this Agreement for any reason under Article 17, NASA will have the right to purchase any such property. The Parties will negotiate in good faith purchase prices for specific items of property. The negotiated prices will be based on ORBITAL's actual costs for purchase or development of the specific item(s), or fair market value, whichever is less. This price will then be discounted by a percentage that reflects the ratio of government funding provided under the Agreement versus the amount of ORBITAL funding used to develop the specific item(s) of property. ($2 of government funds v. $1 of participant funds = 2/3 = 66.6% discount.).

ARTICLE 27. SIGNATURE BLOCK

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

BY: R. Gilbrech
Richard J. Gilbrech
Associate Administrator for Exploration Systems

DATE: 2-19-08

ORBITAL SCIENCES CORPORATION

BY: Antonio L Elias
Dr. Antonio L. Elias
Executive Vice President and General Manager, Advanced Programs Group

DATE: 30 JANUARY 2008

APPENDIX 1

SECTION I. EXECUTIVE SUMMARY (REDACTED)

E1. INTRODUCTION

Orbital's COTS operational system consists of an International Space Station (ISS) visiting vehicle, a new privately-developed medium-class launch vehicle, and all necessary mission planning and operations facilities and services, shown in ***Figure 1.*** This figure also highlights our major COTS subcontractors – Thales Alenia Space (Alenia), the C.S. Draper Laboratory (Draper), Science Applications International Corporation (SAIC) and Odyssey Space Research (Odyssey).

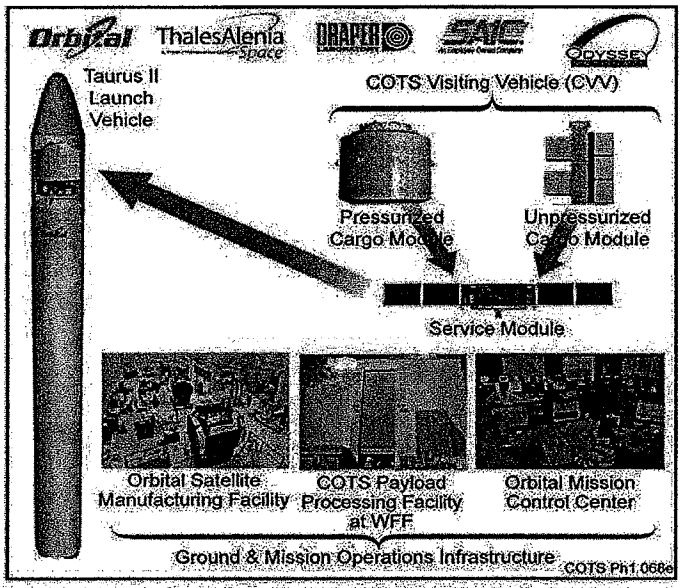


Figure 1. The Major Elements of Orbital's COTS System Architecture Provide Safe, Reliable and Cost-Effective Cargo Delivery to ISS.

Orbital intends to provide private funding to supplement NASA's investment in the COTS demonstration Phase. In order to achieve the lowest possible life-cycle cost over the potential COTS operational service period, Orbital is developing and qualifying a new launch vehicle (called Taurus II) to enable lower-cost COTS launches as well as future NASA science and exploration, commercial and national security space missions. In addition to Orbital's investment, Taurus II benefits from over $30 million in Orbital investments in existing launch vehicle components and subsystems, such as our recently qualified third-generation avionics suite.

Our COTS Visiting Vehicle (CVV) is made up of a common Service Module (SM) with interchangeable pressurized and unpressurized cargo modules. An overview of the features of our COTS operational system is provided in ***Figure 2.***

Highlights of Orbital's COTS Operational System	
Basic System	Capability A and B Cargo Delivery & Disposal (Available 2011 With 2009 ATP) COTS Ph1 070c
Upgraded System	Capability C Cargo Delivery/Return (Available 24 Months After ATP); Extensible to Capability D
COTS Visiting Vehicle	Modular Architecture With High TRL Systems and/or In-Production Systems
	Service Module: Dawn Fault-Tolerant Avionics & Orbital's STAR Spacecraft Propulsion and Power Structure
	Pressurized Cargo Module (PCM): Based on Scaled-Down MPLM Design & Subsystems
	Unpressurized Cargo Module (UCM): Based on ExPRESS Logistics Carrier Design & Interfaces
COTS Launch Vehicle	Multi-Vehicle/Multi-Site Compatibility
	Launchers: Taurus II (Primary), Delta IV and Atlas V (Alternates)
	Launch Sites: Wallops Flight Facility (Primary), Cape Canaveral Air Force Station (Alternate)
COTS Mission Operations	CVV Monitoring and Control by Orbital From Orbital's Mission Control Center in Dulles, Virginia (MCC-D) in Continuous Coordination With NASA Johnson Space Center (JSC) Mission Control Center in Houston (MCC-H)

Figure 2. Orbital's COTS Operational System Provides a Flexible Solution to Capability A and B Missions with Extensibility to Capability C and D.

Summary of COTS Demonstration Mission			
Launch Date			December 2010
Vehicle Config			Operational Service Module Unpressurized Cargo Module
Launch Site			Wallops Flight Facility
Duration			5 Days Minimum Mission Duration
Mission Timeline	Day	1	Launch & CVV Checkout
		2	Orbit Phasing & Collision Avoidance Maneuver Demo
		3	ISS Rendezvous
		4	Approach, Proximity Operations, SSRMS Capture, Simulated Berthing, Release, Departure
		5	On-Orbit Operations, Reentry (Actual Reentry Could Be Deferred for Additional On-Orbit Testing)

COTS Ph1 Pln

Figure 3. Proposed Demonstration Mission Validates Service Module and Key Operations and Procedures.

The COTS Demonstration Mission will fly an operational Service Module (SM) with an Unpressurized Cargo Module (UCM); retire risks associated with rendezvous, proximity operations, and capture by the Space Station Remote Manipulator System (SSRMS); and demonstrate compliance with all ISS visiting vehicle requirements. The demonstration mission is summarized in ***Figure 3***.

In addition to the direct NASA and Orbital investments, 70% of the Service Module's flight-proven components, subsystems and design are used in existing Orbital spacecraft. Examples of these subsystems, shown in ***Figure 4***, represent an investment by Orbital over the past 6 years as well as significant NASA investments under the Dawn program.

Any modifications or new development for both Taurus II and the CVV will be carried out in Orbital's efficient, state-of-the-art launch vehicle and satellite manufacturing facilities.

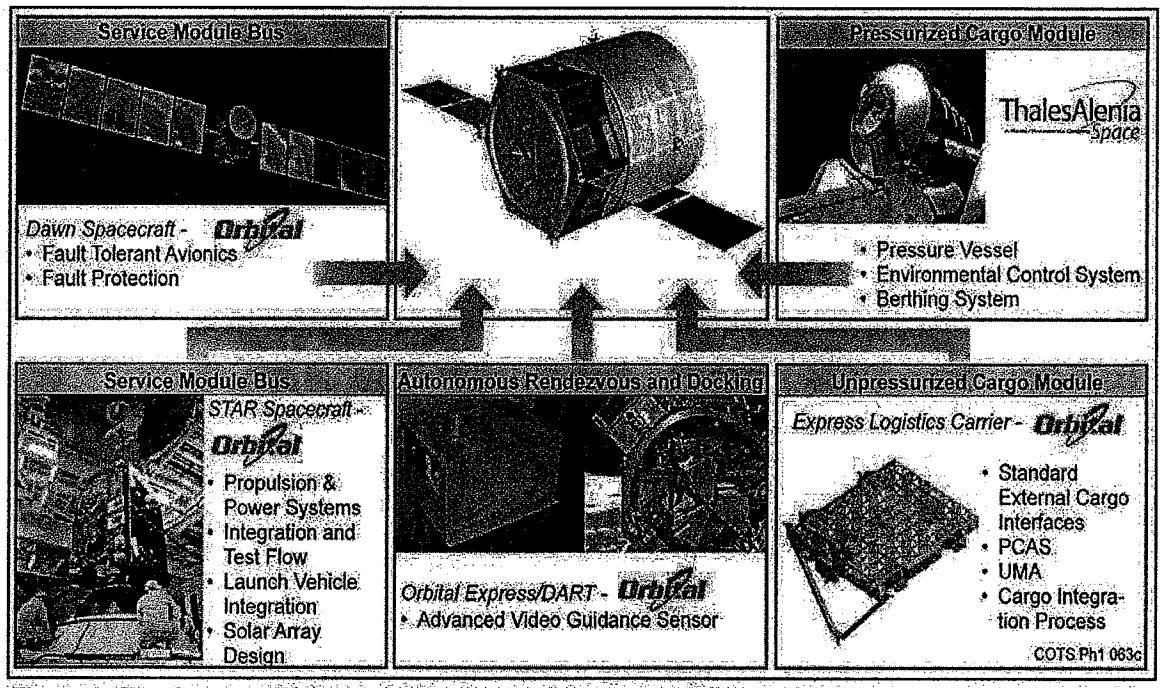


Figure 4. The Cost and Risk of Orbital's Concept are Reduced by Appropriate Re-Use of Heritage Hardware and Designs.

E3. COTS TECHNICAL APPROACH

Our COTS technical approach parallels the two distinct phases of NASA's COTS program. During the demonstration phase (2008-2010), Orbital will develop and qualify a new, lower-cost medium launch vehicle; design, manufacture, qualify and integrate the CVV service module with a UCM; and establish ground infrastructure and mission operations capabilities.

Working closely with NASA, Orbital will also develop the essential human spaceflight safety practices and cost-disciplined commercial protocols in this phase, to support future COTS operational missions. The culmination of this phase will occur in late 2010 with the COTS demonstration flight to ISS where we will demonstrate the rendezvous, proximity operations, SSRMS capture, and simulated berthing at ISS. Building on the results of this initial phase, Orbital will be able to provide operational COTS missions to ISS in the follow-on service phase, with the first such mission(s) taking place in 2011 (assuming a 2009 order).

COTS Launch Vehicle

From the Wallops Flight Facility (WFF) launch site, the basic Taurus II launch vehicle will allow our CVV to deliver 2.3 metric tons (mT) of net pressurized or 2.0 mT of net unpressurized cargo to ISS and dispose of at least the same amounts of mass in a controlled reentry. Taurus II will leverage Orbital's industry-leading experience in developing, building and operating small launch vehicles (totaling over 175 small space and related strategic launch vehicles over two plus decades from 1990 to 2012).

Figure 5 shows the Taurus II launch vehicle as it will be configured for the COTS demonstration mission in 2010.

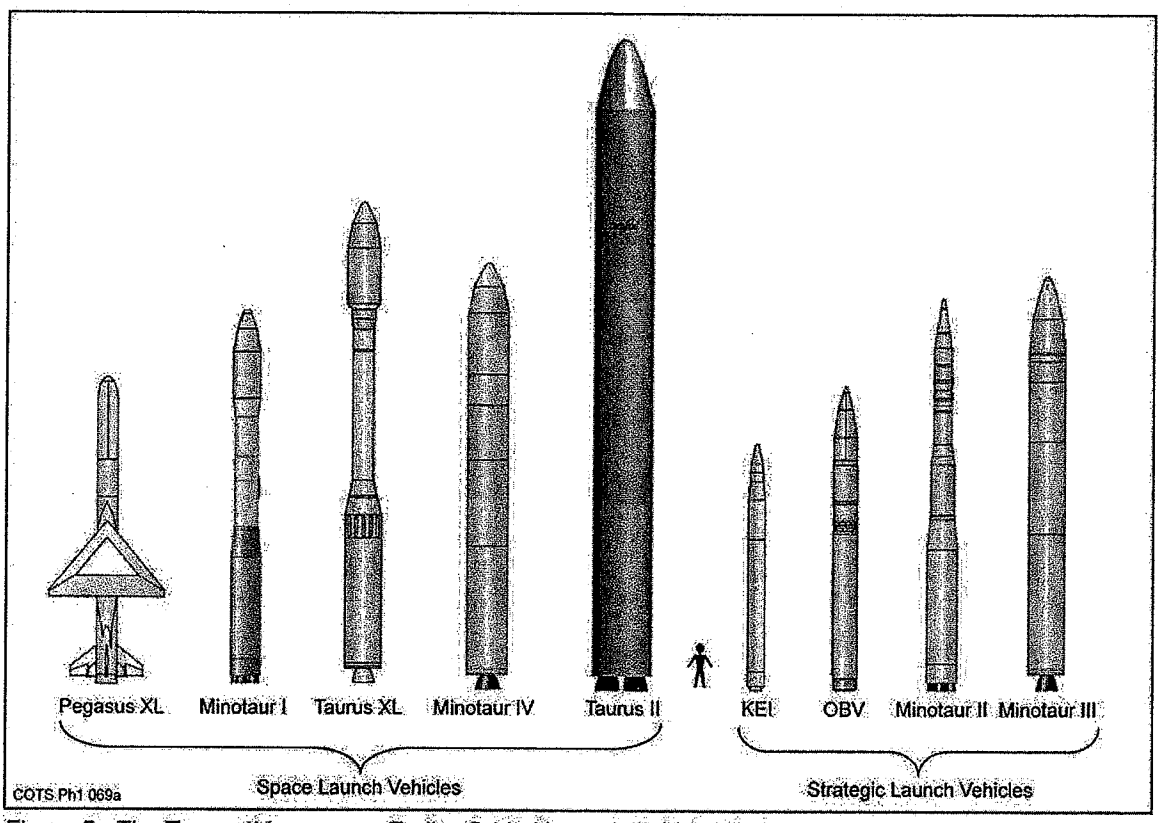


Figure 5. The Taurus II Leverages Earlier Orbital Launch Vehicle Designs.

COTS Visiting Vehicle (CVV)

Our CVV is illustrated in ***Figure*** *7.* It is designed to provide the cargo with electrical power and heat dissipation for the duration of the mission. The CVV is compatible with Orbital's Taurus II launch vehicle as well as other launchers such as the Delta IV and Atlas V EELVs.

The CVV design is based on a common service module that interfaces with one of two cargo modules.

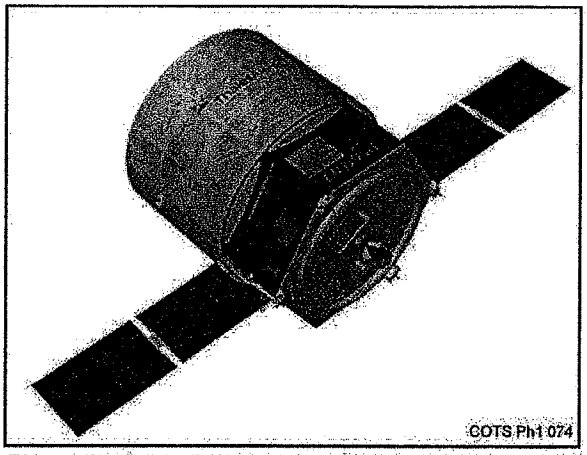


Figure 6. Orbital's Proposed COTS Visiting Vehicle with Pressurized Cargo Module.

The first cargo module is a Pressurized Cargo Module (PCM) similar to the flight-proven Multi-Purpose Logistics Module (MPLM) developed and built by our partner Alenia. Smaller and lighter than the MPLM, the PCM uses a Common Berthing Mechanism (CBM) as the pressurized cargo transfer interface to the ISS. We believe the MPLM-based PCM technology and designs are mature and therefore a demonstration flight of the operational PCM is not required prior to placing it in ISS cargo service.

The second module is the Unpressurized Cargo Module (UCM), used to carry large external cargo units on dedicated flights, such as ISS ORUs. The UCM is designed and built by Orbital and is based on our work for NASA/GSFC on the ExPRESS Logistics Carrier (ELC). The SM is integrated and tested in Orbital's Dulles, Virginia Satellite Manufacturing Facility (SMF), then shipped to Wallops Flight Facility (WFF) where Orbital personnel integrate it with the appropriate loaded cargo module and then integrate the combined CVV to the Taurus II launch vehicle.

COTS Mission Operations

COTS mission operations in the demonstration phase will be based on procedures developed and validated for the H-II Transfer Vehicle (HTV) mission. This will include visiting vehicle monitoring and control by Orbital personnel from Orbital's Mission Control Center in Dulles, VA (MCC-D) in continuous coordination with NASA personnel at Johnson Space Center's (JSC) Mission Control Center in Houston (MCC-H). Following its stay at ISS, the CVV will execute a standard de-orbit/disposal maneuver with a targeted re-entry over the Pacific Ocean.

E5. CONFIRMATION OF ELIGIBILITY REQUIREMENTS

Orbital hereby certifies that this Executive Summary, as well as our complete proposal, is fully compliant with all applicable U.S. laws, regulations and policies, including but not limited to the Iran Nonproliferation Act of 2005, the U.S. Space Transportation Policy of 2005, the Commercial Space Act of 1998, and the Commercial Space Launch Amendments Act of 2004. We also confirm that Orbital, as a publicly-traded company listed on the New York Stock Exchange and organized under the laws of the state of Delaware, is an entity that is more than 50% owned by United States nationals and is eligible to submit this proposal.

APPENDIX 2 – Milestones and Success Criteria

Capability A and B

Milestone 1: Program Plan Review Orbital shall conduct a program plan review meeting with NASA and its subcontractor team to describe the plan for program implementation, which includes management planning for Design, Development, Testing, & Evaluation (DDT&E), integrated program schedule to the element and subsystem level detail through Phase 1 demonstration completion, financing, supplier engagement, risks and anticipated mitigations. Orbital shall provide a presentation of the program plan, along with a hard copy of the presentation materials, and responses to any NASA Action Items. Success Criteria: Successful completion of the program plan review as described above.	Amount: $10,000,000 Date: Mar-08
Milestone 2: Demo Mission SRR Orbital shall conduct a Demo Mission System Requirements Review (SRR) in accordance with the SRR definition in Appendix 3. Success Criteria: Successful completion of the SRR.	Amount: $20,000,000 Date: Jun-08
Milestone 3: Unpressurized Cargo Module (UCM) PDR Orbital shall conduct a UCM Preliminary Design Review (PDR) in accordance with the PDR definition in Appendix 3. Success Criteria: Successful Completion of the PDR	Amount: $10,000,000 Date: Jul-08
Milestone 4: Demo Mission PDR Orbital shall conduct a Demo Mission Preliminary Design Review (PDR) in accordance with the PDR definition in Appendix 3. Success Criteria: Successful completion of the PDR	Amount: $10,000,000 Date: Sep-08

Milestone 5: COTS Integration/Operations Facility at Wallops Flight Facility Started Orbital shall hold a facilities modification final review and construction groundbreaking at the Wallops Flight Facility. Entrance criteria includes: COTS Process Concept of Operation Complete, Planning for all COTS Facility Modifications Complete, Environmental Impact Assessments for COTS Facilities Submitted, and Safety Plans Submitted. Success Criteria: Official Construction Start for the following Facilities: CVV Integration Bay, CVV Fueling Facilities, Cargo Receiving and Processing Bay.	Amount: $10,000,000 Date: Oct-08
Milestone 6: Pressurized Cargo Module (PCM) Preliminary Design Review (PDR) Orbital shall conduct a PCM Preliminary Design Review (PDR) in accordance with the PDR definition in Appendix 3. . Success Criteria: Successful Completion of the PDR	Amount: $20,000,000 Date: Nov-08
Milestone 7: Unpressurized Cargo Module (CDR) Orbital shall conduct a UCM Critical Design Review (CDR) in accordance with the CDR definition in Appendix 3. Success Criteria: Successful Completion of the CDR	Amount: $10,000,000 Date: Nov-08
Milestone 8. Complete Development of Instrumentation Program and Command List (IP&CL). The CVV Instrumentation Program and Command List (IP&CL) will be prepared and released for use shortly before the Demo Mission CDR. The mission database release is required to support development of the CVV Dynamic Spacecraft Simulator (DSS) and to commence integrated avionics hardware/software testing (Milestone 10). For the initial database release, the CVV ground commands and telemetry, as well as CVV stored command sequences (RTS and TMON) will be defined to the extent possible. Success Criteria: Delivery of IP&CL to NASA.	Amount: $10,000,000 Date: Feb-09
Milestone 9: Demo Mission CDR Orbital shall conduct a Demo Mission Critical Design Review (CDR) in accordance with the CDR definition in Appendix 3. Orbital shall also provide	Amount: $20,000,000

review copy of the FAA Licensing Package. Success Criteria: Successful Completion of the CDR.	Date: Mar-09
Milestone 10. COTS Visiting Vehicle (CVV) Avionics Test Orbital shall conduct a CVV Dynamic Avionics Test series which integrates high fidelity models to provide hardware, software, and operations infrastructure validation. Success Criteria: Conclusion by review board that pre-determined test criteria have been accomplished, including: preliminary Dynamic Spacecraft Simulator (DSS) completed, Interface between DSS and Spacecraft Flatsat tested, and Delivery of the Flight Computer EDU.	Amount: $15,000,000 Date: Jun-09
Milestone 11: Unpressurized Cargo Module (UCM) Fabrication Started Orbital shall begin structural fabrication of the UCM deck and related equipment. Entrance criteria includes: Successful completion of the CDR, disposition of all CDR open issues that affect design or fabrication or a timely closure plan exists for those issues remaining open, and adequate design documentation exists to proceed with fabrication. Success Criteria: Release of authorizations to proceed to UCM vendors for fabricated parts.	Amount: $5,000,000 Date: Jul-09
Milestone 12: Service Module Core Assembly Started Orbital shall begin start of propulsion system integration. Assembly begins after delivery of the Service Module core structure and majority of the propulsion components. Success Criteria: Successful completion of a Propulsion Manufacturing Readiness Review, including: core structure accepted, propulsion tanks Accepted, Known Component Discrepancies identified and Dispositioned.	Amount: $7,500,000 Date: Oct-09
Milestone 13: Service Module Test Readiness Review Orbital shall conduct a SM TRR prior to the integration and test phase of the service module, in accordance with the TRR definition in Appendix 3. A Comprehensive Performance Test (CPT) plan shall be developed and provided to NASA for review, with NASA concurrence to be provided for performance parameters associated with ISS interfaces. Success Criteria: Review board acceptance of readiness for start of integration of service module components in Orbital's Satellite Manufacturing Facility.	Amount: $7,500,000 Date: Jan-10

Milestone 14: Service Module Initial CPT Complete First Comprehensive Performance Test (CPT) of the Service Module Complete, in accordance with a detailed CPT test plan. This integrated system test will perform functional testing of all bus subsystems and obtain pre-environmental baseline performance data. Success Criteria: Successful test completion in accordance with the approved CPT Plan.	Amount: $5,000,000 Date: May-10
Milestone 15: Launch Vehicle Stage 1 Assembly Complete Orbital shall complete assembly of the elements of the launch vehicle's first stage. The first stage consists of the Stage 1 core tank structure, the stage 1 Main Engine System (MES), the MES heat shield, the aft skirt, the forward skirt, the avionics, the cable harnesses, and the ordnance. Success Criteria: Stage 1 management state achieves Green Acceptance Tag configuration per Orbital standards. Stage test data is complete and documented. Work package data is complete.	Amount: $5,000,000 Date: Sep-10
Milestone 16: Mission Readiness Review Orbital shall conduct a Mission Readiness Review (MRR) to demonstrate that all elements of the COTS Demo mission are ready, including: launch vehicle, CVV, range safety, and ground systems. Success Criteria: All COTS Demo Mission elements confirmed ready for flight and all residual risks items closed or retired.	Amount: $2,500,000 Date: Oct-10
Milestone 17: Demo Flight Orbital shall complete a demonstration mission that includes each of the following mission phases: launch of the CVV; orbital check-out of CVV systems; rendezvous, proximity operations, SSRMS capture, and integrated operations with ISS; release, and de-orbit of the CVV. Success Criteria: Successful completion of each phase of the demonstration mission.	Amount: $2,500,000 Date: Dec-10

Appendix 3
Success Criteria for COTS
Milestone Reviews

System Requirements Review (SRR), Applicable to Appendix 2 Milestone 2

a. The SRR examines the functional and performance requirements defined for the system and the preliminary program or project plan and ensures that the requirements and the selected concept will satisfy the mission.

b. [Reserved]

c. **Entrance Criteria.** Prior to the execution of the SRR the activities and products identified in Table 3-1 should be completed and documentation provided to all participants fourteen (14) calendar days prior to the review.

d. **Success Criteria.** The review board was able to conclude that the success criteria in Table 3-1 was accomplished to complete the objectives of the SRR.

Table 3-1 SRR Entrance and Success Criteria

System Requirements Review and/or Mission Definition Review	
Entrance Criteria	**Success Criteria**
1. A preliminary SRR agenda, success criteria, and charge to the board have been agreed to by the technical team, manager, and review chair prior to the SRR. 2. NASA and Orbital have formally agreed to the interface requirements defined in SSP 50808, including agreement to tailor or waive any of the SSP 50808 requirements. 3. The following technical products for hardware and software system elements are available to the cognizant participants prior to the review: a. System Architecture b. System requirements document c. System software functionality description d. Updated concept of operations. e. Preliminary system requirements allocation to the next lower level system f. List of major trades. g. Updated risk assessment and mitigations h. Updated schedule data. i. Preliminary software development plan. j.. Preliminary system safety and mission assurance plan. k. Configuration management plan. l. Initial document tree. m. Preliminary verification and validation approach. n. Preliminary hazard analysis outline.	1. The resulting overall concept is reasonable, feasible, complete, responsive to the mission requirements, and is consistent with system requirements and available resources (cost, schedule, mass power, etc.). 2. The program, utilizes a sound process for the allocation and control of requirements throughout all levels, and a plan has been defined to complete the definition activity within schedule constraints. 3. Requirements definition is complete with respect to top level mission and science requirements, and interfaces with external entities and between major internal elements have been defined. 4. Requirements allocation and flow down of key driving requirements have been completed down to subsystems. 5. System and subsystem design approaches and operational concepts exist and are consistent with the

	requirements set. 7. Preliminary approaches have been determined for how requirements will be verified and validated down to the subsystem level. 8. Major risks have been identified, and viable mitigation strategies have been defined.

Preliminary Design Review (PDR), Applicable to Appendix 2 Milestones 3 and 6

a. The Preliminary Design Review (PDR) demonstrates that the preliminary design meets all system requirements with acceptable risk and within the cost and schedule constraints and establishes the basis for proceeding with detailed design. It will show that the correct design option has been selected, interfaces have been identified, and verification methods have been described.

b. PDR occurs near the completion of the preliminary design phase.

c. **Entrance Criteria.** Prior to the execution of the PDR, the activities and products identified in Table 3-2 should be completed and documentation provided to all participants fourteen (14) calendar days prior to the review.

d. **Success Criteria.** The review board was able to conclude that the success criteria in Table 3-2 was accomplished to complete the objectives of the PDR.

Table 3-2 – PDR Entrance and Success Criteria

Preliminary Design Review	
Preliminary Design Review	**Success Criteria**
1. A preliminary PDR agenda, success criteria, and charge to a the board have been agreed to by the technical team, program manager, and review chair prior to the PDR. 2. A Phase 1 Safety Data Package (SDP) has been delivered to NASA and the ISS Safety Review Panel (SRP) has authorized Orbital to proceed to the Phase 2 Safety Review. 3. PDR technical products listed below for both hardware and software system elements have been made available to the cognizant participants prior to the review: a. Updated baseline documentation, as required. b. Preliminary subsystem design specifications for each configuration item (hardware and software), with supporting tradeoff analyses and data, as required.	1. Agreement exists for the top-level requirements, including mission success criteria, Technical Performance Measures (TPMs), and any sponsor-imposed constraints, and that these are finalized, stated clearly, and are consistent with the preliminary design. 2. The flow down of verifiable requirements is complete and proper or, if not, an adequate plan exists for timely resolution of open items. requirements are traceable to mission goals and objectives. 3. The preliminary design is expected to meet the requirements at an acceptable level of risk. 4. Definition of the technical interfaces is

The preliminary software design specification needs to include a completed definition of the software architecture and a preliminary database design description as applicable. c. Updated risk assessment and mitigation. d. Updated schedule data. e. Preliminary logistics data. f. Applicable technical plans (e.g., technical performance measurement plan, contamination control plan, parts management plan, environments control plan, EMI/EMC control plan, quality assurance plan, etc.) g. Applicable standards. h. Preliminary safety analyses and plans. i. Engineering drawing tree. j. Interface control documents. k. Verification/validation plan. l. Plans to respond to regulatory requirements (e.g., Environmental Impact Statement), as required. m. System-level hazard analysis. n. Preliminary limited life items list (LLIL).	consistent with the overall technical maturity and provide an acceptable level of risk. 6. Adequate technical margins exist with respect to technical performances measures (TPMs). 7. The program, risks are understood, and plans and a process and resources exist to effectively manage them. 8. Safety and mission assurance (i.e., safety, reliability, maintainability, quality, and EEE parts) have been adequately addressed consistent with the overall technical maturity. 9. The operational concept is technically sound, that it includes (where appropriate) human factors that apply and that requirements for its execution flow down.

Critical Design Review (CDR), Applicable to Appendix 2 Milestones 7 and 9

a. The purpose of the CDR is to demonstrate that the maturity of the design is appropriate to support proceeding with full scale fabrication, assembly, integration and test, and that the technical effort is on track to complete the flight and ground system development and mission operations in order to meet mission performance requirements within the identified cost and schedule constraints.

b. CDR occurs near the completion of the final design phase and generally before entering the fabrication, assembly, and qualification phase.

c. **Entrance Criteria.** Prior to the execution of the CDR, the activities and products identified in Table 3-3 should be completed and documentation provided to all participants fourteen (14) days prior to the review.

d. **Success Criteria.** The review board was able to conclude that the success criteria in Table 3-3 was accomplished to complete the objectives of the CDR.

Table 3-3 – CDR Entrance and Success Criteria

Critical Design Review	
Entrance Criteria	**Success Criteria**
1. Successful completion of the PDR and responses have been made to all PDR open issues, or a timely closure plan exists for those remaining open.	1. The detailed design is expected to meet the requirements with adequate margins at an acceptable level of risk.

2. A preliminary CDR agenda, success criteria, and charge to the program manager and review chair prior to the CDR. 3. A Phase 2 Safety Data Package (SDP) has been delivered to NASA and the ISS Safety Review Panel (SRP) has authorized Orbital to proceed to the Phase 3 Safety Review. 3. CDR technical products listed below for both hardware and software system elements have been made available to the cognizant participants fourteen (14) days prior to the review: a. Updated baseline documents as required b. Product build-to specifications for each hardware and software configuration item, along with supporting trade-off analyses and data. c. Fabrication, assembly, integration, and top-level test plans and procedures. d. Technical data (e.g., Integrated Schematics, Spares Provisioning List, engineering analyses, specifications, etc.). e. Interface Control Documents (e.g. Command and Telemetry List, instrumentation, electrical, Mechanical, fluids & gas interfaces, User Interfaces. f. Preliminary Test Requirements document (e.g. Operational Limits and Constraints, acceptance criteria). g. Verification & Validation Plan (including requirements and specifications). h. Launch Site Operations Plan (including Checkout and Activation Plan). i. Updated risk assessment and mitigation. j. Updated schedule data. k. Updated logistics documentation. l. Updated LLIL. m Subsystem-level and preliminary operations hazards analyses. n. Systems and subsystem certification plans and requirements (as needed). o. System hazard analysis with associated verification.	2. Interface control documents are appropriately matured to proceed with fabrication, assembly integration and test, and plans are in place to manage any open items. 3. High confidence exists in the product baseline, and adequate documentation exists and/or will exist in a timely manner to allow proceeding with fabrication. 4. The product verification and product validation requirements and plans are complete. 5. The testing approach is comprehensive, and the planning for system assembly, integration, test, and launch site and mission operations is sufficient to progress into the next phase. 6. Adequate technical and programmatic margins and resources exist to complete the development within budget, schedule, and risk constraints. 7. Risks to mission success are understood, and plans and resources exist to effectively manage them. 8. Safety and mission assurance (i.e., safety, reliability, maintainability, quality, and EEE parts) have been adequately addressed in system and operational designs and any applicable S&MA products (i.e., hazard analysis and failure modes and effects analysis) have been approved.

Test Readiness Review (TRR), Applicable to Appendix 2 Milestone 13

a. A TRR ensures that the test article (hardware/software), test facility, support personnel, and test procedures are ready for testing and data acquisition, reduction and control.

b. A TRR is held prior to major system tests.

c. **Entrance Criteria.** Prior to the execution of a TRR, the activities and products identified in Table 3-4 should be completed and documentation provided to all participants fourteen (14) days prior to the review.

d. **Success Criteria.** The review board was able to conclude that the success criteria in Table 3-4 was accomplished to complete the objectives of a TRR.

Table 3-4 – TRR Entrance and Success Criteria

Preliminary Design Review	
Entrance Criteria	**Success Criteria**
1. The objective of the test have been clearly defined and documented and that all of the plans and procedures support those objectives. 2. Configuration of system under test has been defined and agreed to. All interfaces have been placed under configuration management or have been defined in accordance within an agreed to plan, and a version description document has been made available to TRR participants prior to the review. 3. All applicable functional, unit level, subsystem, system and qualification testing has been conducted successfully. 4. All TRR specific materials, such as test plans, test cases, and procedures have been available to all participants prior to conducting the review. 5. All known system discrepancies have been identified and dispositioned in accordance with an agreed upon plan. 6. All previous design review success criteria and key issues have been satisfied in accordance with an agreed upon plan. 7. All required resources (people, facilities, test articles, test instrumentation) have been identified and are available to support required tests. 8. Roles and responsibilities of all participants are defined and agreed to. 9. Test contingency planning has been accomplished, and all personnel have been trained.	1. Adequate plans and procedures are completed and approved. 2. Adequate identification and coordination of required resources is completed. 3. Previous component, subsystem, system test results form a satisfactory basis for proceeding into planned test. 4. Risk level is identified and accepted by program/ leadership as required. 5. Plan to capture any lessons learned from the test. 6. The objective of the test has been successfully validated. 7. Test goals defined, documented and agreed upon.