

Attachment J-03, Appendix A, Milestone Acceptance Criteria and Payment Schedule

Certification Baseline Review (CBR) Interim Milestone

Amount: \$ [REDACTED]

Planned Start Date and Completion Date (mo/yr): November 2014

Data/Data Requirement Deliverables (DRDs) to be provided: DRD 001, DRD 002, DRD 101, DRD 102, DRD 107, DRD 108, DRD 109, DRD 201, DRD 203, DRD 205, DRD 206, Key Performance Design Parameters Matrix, SSP 50833 COTS Cargo Interface Requirements Document, SSP 50977 ISS to COTS ICD for SpaceX Commercial Crew Transpiration System, Joint Integrated Verification Test Plan (JiVTP), BDEALS, BSHEALS, Concept of Operations Document, Crew Dragon Design Document, Falcon 9 Design Document, Dragon Software Requirements Baseline Document, Falcon Software Requirements Baseline Document, Software Design and Capabilities Baseline, Crew Dragon Schematics, Falcon 9 Schematics, Crew Dragon Bill of Materials, Falcon 9 Bill of Materials, Crew Dragon Thermal Analysis, Falcon 9 CAD Models, Crew Dragon CAD Models, System Safety Process, Human Error Analysis, Integrated Probabilistic Safety Analysis, Hazard Report Status, Fault Tolerance Assessment, Crew Survival Strategy, Margin Management Report, Crew Training Template, Crew Master Task List, Crew Task Analysis, Crew Workload and Usability Evaluations, Crew-In-The-Loop Test Plan, Risk Management Status, Final Management Plans and Products

Delivery of Data/DRDs (mo/yr): NLT 45 days before milestone reference **DRD 101 Milestone Review Plan**

Objective: At a NASA and Contractor co-chaired Certification Baseline Review (CBR) completed within ninety (90) days of contract start, the Contractor shall:

- (a) Identify the Baseline requirements, including the allocation to the Elements and Subsystems of the CTS, incorporating the results of NASA's guidance provided under Certification Products Contract (CPC) (if applicable), which meet NASA's requirements defined in CCT-REQ-1130, *ISS Crew Transportation and Services Requirements Document* and SSP 50808, *International Space Station (ISS) to Commercial Orbital Transportation Services (COTS) Interface Requirements Document*.
- (b) Identify the current Crew Transportation System (CTS) design baseline.
- (c) Document management plans and products incorporating the results of NASA's disposition provided under Certification Products Contract (CPC) (if applicable), to meet requirements in the CCT-PLN-1120, *Crew Transportation Technical Management Processes*.
- (d) Define the plan and schedule to complete Design, Development, Test, and Evaluation (DDTE) and certification for the CTS design, production, and operations.
- (e) Define top safety, technical, cost and schedule risks based on most current CTS design.

NNK14MA74C - Commercial Crew Transportation Capability (CCtCap) Contract

Indicators of Milestone Readiness:

The Contractor has completed the following and provided to NASA:

- (a) The requirements, including the allocation to the Elements and Subsystems of the CTS, incorporating the results of NASA's disposition under CPC (if applicable) which meet NASA's requirements defined in CCT-REQ-1130 and SSP 50808 including but not limited to:
 - (1) Documentation of previously approved variances and alternate standards incorporated or tailored in requirements
 - (2) Provide joint ISS integration products (Interface Control Documents (ICDs), Joint Integrated Verification Test Plan (JiVTP), Bi-lateral Data Exchange Agreement List and Schedule (BDEALS), Bi-lateral Hardware Software Exchange Agreement List and Schedule (BHSEALS)) identified in SSP 50964, *Visiting Vehicle ISS Integration Plan*.
- (b) Documentation of the current CTS design baseline as defined in **DRD 102 Certification Baseline Review (CBR) Data Package**.
- (c) The management plans and products as defined in **DRD 102 Certification Baseline Review (CBR) Data Package**.
- (d) The **DRD 108 Verification and Validation (V&V) Plan**.
- (e) The **DRD 107 Certification Plan**.
- (f) The **DRD 002 Integrated Master Plan and Integrated Master Schedule** for CTS Certification activities.
- (g) An assessment of the top safety, technical, cost, and schedule risks to CTS Certification, and documentation of the approach to manage and accept risk with CTS Certification.
- (h) **DRD 001 Insight Implementation Plan** and documentation of the organizational interaction and personnel interfaces to achieve the objectives of the Insight Implementation Plan and Insight Clause.
- (i) **DRD 101 Milestone Review Plan**.
- (j) **DRD 109 Flight Test Plan**.

Acceptance Criteria:

- (a) Requirements are baselined and controlled. The allocation of requirements to the CTS design baseline is complete.
 - (1) Requirements are traceable to CCT-REQ-1130 and SSP 50808.

- (2) Variances and alternate standards have been incorporated and appropriately tailored into the Contractor's requirements.
- (3) Technical coordination is complete for joint ISS integration products (ICDs, JiVTP, BDEALS, BHSEALS) identified in SSP 50964, and products are ready for ISS to baseline post CBR review.
- (4) The Concept of Operations has been baselined.
- (b) The CTS design definition products identified in the **DRD 102 Certification Baseline Review (CBR) Data Package** identify the current design baseline.
- (c) Integrated vehicle performance and design margin is appropriate and supports completion of development.
- (d) Management plans and products identified in the **DRD 102 Certification Baseline Review (CBR) Data Package** are in place, controlled and are being implemented. The plans and products identified in the CBR Data Package as type 2 have been approved.
- (e) The **DRD 108 V&V Plan** has been Baselined.
- (f) The **DRD 107 Certification Plan** has been Baselined.
- (g) An **DRD 002 Integrated Master Plan and Integrated Master Schedule (IMP/IMS)** has been approved.
- (h) The top safety, technical, cost and schedule risks are identified, assessed, and clearly communicated. Plans, processes, and appropriate resources necessary to effectively manage the risks are in place.
- (i) **DRD 001 Insight Implementation Plan** has been approved. The organizational interaction and personnel interfaces to achieve the objectives of the Insight Implementation Plan and Insight Clause have been documented.
- (j) **DRD 101 Milestone Review Plan** in accordance with the Data Requirement List (DRL) and DRD has been approved.
- (k) **DRD 109 Flight Test Plan** in accordance with the DRL and DRD has been approved.
- (l) A plan and schedule have been defined for the resolution of all actions and open items resulting from the CBR. All To be Determined (TBD) and To be Resolved (TBR) items are clearly identified with acceptable plans and schedules for their disposition.

Design Certification Review (DCR) Interim Payment Milestone
Initial Propulsion Module Testing Complete

Amount: \$ [REDACTED]

Planned Start Date and Completion Date (mo/yr): April 2015

Data/Data Requirement Deliverables (DRDs) to be provided: Propulsion Module Test Plan, quick-look test report

Delivery of Data/DRDs (mo/yr): NLT 30 days before milestone (except as noted below)

Objective: [REDACTED]

[REDACTED]

[REDACTED]

way as to isolate the anomaly and allow for continued operation, or safing/shutdown of the

Indicators of Milestone Readiness:

- (a) Propulsion module test plan delivered to NASA at least 30 days before the start of the test campaign. The test plan will contain, at a minimum:
 - (1) Primary and secondary (if any) test objectives.
 - (2) Key differences between the test article and flight propulsion system.
 - (3) Test conditions and environment.
 - (4) Test matrix.
 - (5) Instrumentation list.
- (b) All applicable components acceptance-tested.
- (c) Assembly of the propulsion module test article completed.
- (d) Non-reactive testing of the propulsion module completed, including:
 - (1) Propulsion system leak checks and functional tests.
 - (2) Avionics checkouts.
- (e) Propulsion module test readiness review (TRR) completed before starting the test campaign.
- (f) All action items from the test readiness review (if any) are answered or dispositioned.

Acceptance Criteria:

- (a) Demonstrate a high-altitude abort profile requiring both SuperDraco and Draco firings with abort bottles.
- (b) Demonstrate representative rendezvous and docking thruster firing sequences.
- (c) Demonstrate a propulsive-assisted landing thrust profile using SuperDraco engines with Draco thrusters for roll control.
- (d) Obtain data for FDIR threshold determination.
- (e) Test results satisfy primary test plan objectives and support the certification plan, or a process is in place to disposition any open items.
- (f) Quick-look test report delivered to NASA within 10 days of test completion.

Design Certification Review (DCR) Interim Payment Milestone
Avionics Test Bed Activation

Amount: \$ [REDACTED]

Planned Start Date and Completion Date (mo/yr): May 2015

Data/Data Requirement Deliverables (DRDs) to be provided: HITL test bed schematics, HITL test bed initial power up and data checkout procedure, quick-look test report

Delivery of Data/DRDs (mo/yr): NLT 30 days before milestone (except as noted below)

Objective: [REDACTED]

[REDACTED]

Indicators of Milestone Readiness:

- (a) Delivery of flight-like flight computer box to HITL test bed.
- (b) Delivery of power box to HITL test bed.
- (c) Delivery of vehicle remote-IO box to HITL test bed.
- (d) Harnessing between flight computer box, power box, and vehicle remote-IO box delivered and installed on the test bed.
- (e) Sufficient electrical ground support infrastructure to support power-up and box control.
- (f) Flight software booting on flight computer box, power box, and vehicle remote-IO box.
- (g) Flight software able to control powered loads on the power box and establish bi-directional network communication from the flight computer box to the power box and vehicle remote-IO box.
- (h) Telemetry defined to demonstrate voltage being applied to individual powered loads.

- (i) Telemetry defined to demonstrate bi-directional network communication.
- (j) SpaceX has completed the following and delivered to NASA no later than 30 days before the activation:
 - a. HITL test bed schematics.
 - b. HITL test bed initial power up and data checkout procedure.

Acceptance Criteria:

- (a) Demonstrate ability to power-up test bed.
- (b) Demonstrate ability to control individual powered loads on the power box.
- (c) Demonstrate end-to-end bi-directional network communication between flight computer and power box.
- (d) Demonstrate end-to-end bi-directional network communication capability between flight computer and vehicle remote-IO box.
- (e) Quick-look test report, showing test bed hardware and telemetry collected from demonstrations above, delivered to NASA within 10 days of test completion.

Design Certification Review (DCR) Interim Payment Milestone
Delta Critical Design Review (dCDR)

Amount: \$ [REDACTED]

Planned Start Date and Completion Date (mo/yr): June 2015

Data/Data Requirement Deliverables (DRDs) to be provided: Final concept of operations document; detailed trajectory analysis; detailed GNC analysis; initial set of crew and ground electronic procedures; crew and ground operator display dictionary; detailed thermal analysis; detailed environmental control and life support analysis; detailed loads, environments and structural analysis; detailed wind tunnel and CFD aerodynamic reports; drawings for Dragon and Falcon 9; schematics for all Dragon, Falcon 9 and launch pad systems; DRD 107; DRD 108; DRD 205

Delivery of Data/DRDs (mo/yr): NLT 30 days before milestone

Objective: The purpose of the Delta Critical Design Review (dCDR) is to ensure that the detailed Dragon-Falcon 9 System design will satisfy all applicable requirements with adequate margins; is sufficiently mature to proceed with fabrication, assembly, integration, and test; and has completed the product verification and validation plans with NASA's approval. This design review will be co-chaired by NASA and SpaceX in accordance with our Milestone Review Plan (DRD 101). The review will cover all four elements of our crew transportation system: the Crew Dragon spacecraft, Falcon 9 launch vehicle, ground operations, and mission operations. SpaceX will present sufficiently mature designs for each of these elements to demonstrate compliance with all CCT-REQ-1130 and SSP 50808 requirements, or with NASA-approved variances. We will present details of our testing, integration and operations approach, which will need to be approved by NASA before we can proceed to the next phase of the program plan. We will also update performance margins to demonstrate that they are sufficient to complete the development efforts and we will provide updates to identified risks and their mitigations.

Indicators of Milestone Readiness: SpaceX has completed the following and provided it to NASA at least 30 days before the review:

- (a) Final concept of operations document, detailing all concepts of operations from ground processing through post-landing.
- (b) Detailed trajectory analysis for the Dragon-Falcon 9 ascent phase.
- (c) Detailed GNC analysis for ascent aborts, rendezvous and proximity operations, and entry.
- (d) Initial set of crew and ground electronic procedures (eProcs).
- (e) Complete crew and ground operator display dictionary.
- (f) Detailed thermal analysis.
- (g) Detailed environmental control and life support analysis.
- (h) Detailed loads, environments and structural analysis.
- (i) Detailed wind tunnel and CFD aerodynamic reports.

- (j) Drawings for Dragon and Falcon 9
- (k) DRD 205 CAD model for Dragon and Falcon 9.
- (l) Schematics for all Dragon, Falcon 9 and launch pad systems.
- (m) DRD 107 Verification and Validation Plan
- (n) DRD 108 Certification Plan

Acceptance Criteria:

- (a) Critical designs for all relevant Dragon-Falcon 9 Crew Vehicle and launch pad systems and subsystems presented to sufficient level of detail.
- (b) Comprehensive design presented at sufficient maturity level to show that system requirements will be met and that the program is ready to proceed with fabrication, assembly, integration, and test of all articles required for the optional period milestones.
- (c) Testing approach is comprehensive and planning for system assembly integration, test, and launch site and mission operations is sufficient to progress into the next phase.
- (d) Updated Integrated Master Schedule presented.
- (e) Adequate technical and programmatic margins and resources exist to complete the development within budget, schedule and risk constraints.
- (f) Updates to risk assessments and mitigation strategies presented.
- (g) Risks to mission success are understood and plans and resources exist to effectively manage them.
- (h) NASA approval obtained to proceed with fabrication, assembly, integration, and test activities to support verification and validation.

Design Certification Review (DCR) Interim Payment Milestone
Docking System Qualification Testing Complete

Amount: \$ [REDACTED]

Planned Start Date and Completion Date (mo/yr): August 2015

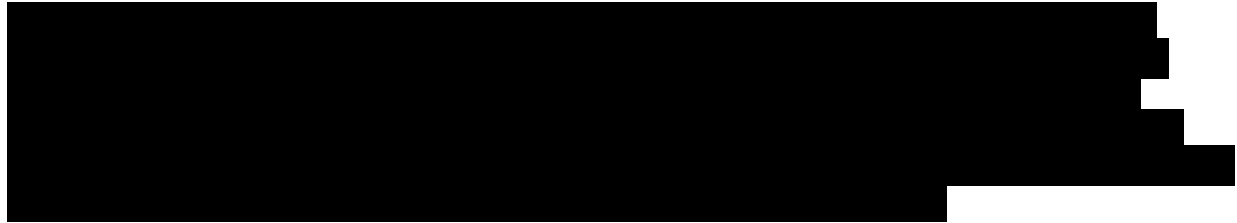
Data/Data Requirement Deliverables (DRDs) to be provided: Docking adapter qualification plan, qualification docking adapter manufacturing work orders, quick-look test report(s)

Delivery of Data/DRDs (mo/yr): NLT 30 days before milestone (except as noted below)

Objective: [REDACTED]

[REDACTED]

[REDACTED]



Indicators of Milestone Readiness:

- (a) All docking system action items from the dCDR are answered or dispositioned.
- (b) Fabrication and assembly of the qualification units completed.
- (c) Fabrication and checkout of SpaceX 6-DOF HITL test bed.
- (d) Docking adapter qualification plan delivered to NASA at least 30 days before starting the test campaign. The test plan will include:
 - (1) Primary and secondary (if any) test objectives.
 - (2) Key differences (if any) between the test article and the flight docking adapter.
 - (3) Test conditions and environment.
 - (4) Test matrix.
 - (5) Instrumentation list.
- (e) Docking adapter qualification test readiness review (TRR) completed before beginning the test campaign.
- (f) Qualification docking adapter manufacturing work order delivered to NASA no later than 30 days before starting the test campaign.

Acceptance Criteria:

- (a) Demonstrate high probability of successful soft capture through a range of expected initial conditions using the dynamic analysis model that has been anchored by testing with the JSC 6-DOF test bed.
- (b) Qualification test results satisfy primary test plan objectives and support the certification plan, or a process is in place to disposition any open items.
- (c) Quick-look test report(s) delivered to NASA within 10 days of test completion.

Design Certification Review (DCR) Interim Payment Milestone
Propulsive Land Landing Test Complete

Amount: \$ [REDACTED]

Planned Start Date and Completion Date (mo/yr): September 2015

Data/Data Requirement Deliverables (DRDs) to be provided: Final Propulsive Land Landing Test Plan, test operation procedures, quick-look test report

Delivery of Data/DRDs (mo/yr): NLT 30 days prior before milestone (except as noted below)

Objective: SpaceX will conduct a propulsive landing test of Dragon under nominal hardware conditions. The vehicle will be dropped from an altitude sufficient to deploy parachutes and approach the landing burn under flight-like conditions. The intent of the test is to integrate the parachute, navigation, and propulsion systems into Dragon to demonstrate landing with command and control, as well as data acquisition. The test article will closely match the flight configuration's mechanical properties, such as the outer mold line for aerodynamic accuracy, maximum gross mass, moment of inertia, and center of mass location. The purpose for conducting the propulsive landing test is to demonstrate the safety and effectiveness of the Dragon propulsive landing system on flight-like hardware—including the altimeter—and to validate dynamic models for the vehicle under main parachutes. The SuperDraco assisted propulsive landing provides a fault tolerant low impact landing although Dragon can land safely under parachutes only.

Indicators of Milestone Readiness:

- (a) Final Propulsive Land Landing Test Plan delivered to NASA at least 30 days before the test.
The test plan will include:
 - (1) Primary and secondary (if any) test objectives.
 - (2) Configuration of the test unit.
 - (3) Key differences between test unit and flight unit.
 - (4) Instrumentation plan.
 - (5) Pretest performance predications based on GNC simulations.
 - (6) Test conditions and environment.
- (b) Test operation procedures released at least 15 days before the test.
- (c) Propulsive landing test dry runs/simulations completed.
- (d) All applicable components acceptance-tested.
- (e) HITL testing of flight software performed.
- (f) Assembly of the propulsive landing test article completed.
- (g) Non-reactive testing of the propulsive landing test article completed, including:

NNK14MA74C - Commercial Crew Transportation Capability (CCtCap) Contract

- (1) Structural load testing.
- (2) Propulsion system leak checks and functional tests.
- (3) Avionics checkouts.
- (h) Test readiness review completed at least 7 days before test.
- (i) All action items from the test readiness review (if any) answered or dispositioned.
- (j) FAA, Range Safety, and/or other applicable government approvals for the test demonstration received.

Acceptance Criteria:

- (a) Propulsive landing test conducted.
- (b) Test results satisfy primary test plan objectives and support the certification plan, or a process is in place to disposition any open items.
- (c) Telemetry including propulsion, GNC, and avionics sensors recorded or transmitted.
- (d) Environmental data for landing acoustics, induced random vibration, and landing dynamics recorded.
- (e) Quick-look test report delivered to NASA within 10 days of test completion.

Design Certification Review (DCR) Interim Payment Milestone
Launch Site Operational Readiness Review

Amount: \$ [REDACTED]

Planned Start Date and Completion Date (mo/yr): November 2015

Data/Data Requirement Deliverables (DRDs) to be provided: Internal design review documentation, pad operations hazard analyses, quick-look test report

Delivery of Data/DRDs (mo/yr): NLT 30 days before milestone (except as noted below)

Objective: SpaceX will demonstrate that the launch site meets CCT-REQ-1130 requirements with an acceptable level of risk for completing the Flight to ISS without Crew milestone. NASA and SpaceX personnel will evaluate the effectiveness of the pad escape system as part of a separate milestone before the Flight to ISS with Crew Milestone. This first Launch Site Operational Readiness Review will demonstrate that the launch complex is ready to support launches of the Dragon-Falcon 9 Crew Vehicle.

Indicators of Milestone Readiness:

- (a) Successful completion of prerequisite SpaceX internal design reviews and hardware build for:
 - (1) Lightning protection system.
 - (2) Launch complex service structure.
 - (3) Pad transportation and handling ground support equipment, including the transporter-erector.
 - (4) Launch site fluids system, [REDACTED]
 - (5) Launch pad communications systems.
 - (6) Emergency subsystems, including fire-suppression system and emergency breathing gas.
- (b) System safety approval for pad operations.
 - (1) Pad operations hazard analysis completed and delivered to NASA no later than 30 days prior to the review.
- (c) Internal design review documentation delivered to NASA no later than 30 days prior to the review.

Acceptance Criteria:

- (a) Pad integrity test complete.

- (b) Propellant and gas flow test complete.
- (c) Transporter-erector demonstration complete.
- (d) Functionality of overall system successfully demonstrated.
- (e) Quick look test report delivered to NASA within 10 days of test completion.

Design Certification Review (DCR) Interim Payment Milestone
Flight Test without Crew Certification Review (FTCR)

Amount: \$ [REDACTED]

Planned Start Date and Completion Date (mo/yr): December 2015

Data/Data Requirement Deliverables (DRDs) to be provided: DRD 109 Flight Test Plan for Flight to ISS without Crew; DRD 110 applicable ISS integration and CCP hazard reports; DRD 111 applicable CCT-REQ-1130 and SSP 50808 verification closure notices; DRD 113; DRD 114; Launch and reentry certification data package materials including: preliminary flight data package (PFDP) tailored for Falcon 9; orbital debris assessment reports (ODAR), end of mission plans (EOMP), reentry data package, reentry trajectory data, accident investigation plan, Dragon first responders guide, Dragon reentry flight rules, and recovery operations summary; and Applicable hardware and software items in Appendix G of SSP 50964.

Delivery of Data/DRDs (mo/yr): NLT 45 days before milestone

Objective: The FTCR will certify the design and safety of the Flight to the ISS without Crew. SpaceX will complete relevant CCT-REQ-1130 and all SSP 50808 ISS integration activities for the Dragon-Falcon 9 Crew Vehicle, ground segment, and mission operation elements in preparation for a mission to the ISS without crew.

Partial certification to CCT-REQ-1130 will be focused on those VCNs and hazard reports which ensure adequate safety provisions are in place and risks are acceptable for the ascent, and the entry, descent and landing phases of flight. The review is a critical gate on the road to full certification and provides NASA the opportunity to assess safety risks and gain confidence in the validation activities associated with the Flight Test to the ISS without crew. [REDACTED]

A key predecessor to this FTCR will be the completion of ISS integration. ISS integration is the set of activities required to ensure that ISS requirements (per SSP 50808, ISS to COTS IRD) have been met; hardware and software needed to interface with the ISS has been completed; and joint on-orbit integration operations plans and products have been finalized. [REDACTED]

Indicators of Milestone Readiness:

SpaceX has completed the following and provided NASA with all data products 45 days before FTCR:

- (a) Successful completion of ISS Post Qualification Review (PQR) including:
 - (a) Delivery of applicable hardware and software items in SSP 50964 (Visiting Vehicle ISS Integration Plan), Appendix G with

- (1) Path forward for open items jointly agreed to between SpaceX and NASA.
 - (2) Delivery and closure of applicable SSP 50808 Verification & Validation products (all requirements less standard open items).
 - (3) Path forward for open items jointly agreed to between SpaceX and NASA.
 - (4) Delivery and closure of applicable ISS integration hazard reports and completion of the Phase III Safety Review Panel associated with SSP 50808.
 - (5) Approval from the ISS Program and PQR Board to approach and dock to the ISS.
- (b) SpaceX has completed the following and provided it to NASA at least 45 days before the review:
- (1) Preliminary flight data package (PFDP) tailored for Falcon 9
 - (2) Orbital debris assessment report (ODAR)
 - (3) End of mission plans (EOMP)
 - (4) Reentry data package
 - (5) Reentry trajectory data
 - (6) Accident investigation plan
 - (7) Dragon first responders guide
 - (8) Dragon reentry flight rules
 - (9) Recovery operations summary
 - (10) Applicable CCT-REQ-1130 hazard reports in accordance with DRD 110 Hazard Reports
 - (11) Applicable CCT-REQ-1130 VCNs in accordance with DRD 111 Verification Closure Notices (VCN)
 - (12) DRD 113 Range Safety Data Documentation
 - (13) DRD 114 CTS Data Input for NASA Integration and Independent Verification and Validation
- (c) Delivery of all items needed for the flight operations review.
- (d) Completion of applicable flight hardware component acceptance testing.
- (e) Completion of applicable hardware qualification testing.
- (f) Most vehicle integrated system testing and as-built inspections completed.
- (g) Initial flight test plan submitted to NASA.

Acceptance Criteria:

- (a) Approval from the Commercial Crew Program to ensure appropriate safety risk of the flight test to the ISS without crew has been satisfied based on the VCN and Hazard Report closures.
- (b) Open items reviewed with NASA.
- (c) Risks associated with the uncrewed missions to the ISS reviewed with NASA.

- (d) NASA and SpaceX management jointly provide authority to proceed for Flight to ISS without Crew milestone.

Design Certification Review (DCR) Interim Payment Milestone
ECLSS Integrated Test Complete

Amount: \$ [REDACTED]

Planned Start Date and Completion Date (mo/yr): February 2016

Data/Data Requirement Deliverables (DRDs) to be provided: ECLSS Module Integrated Test Plan, ECLSS module and GSE schematics, test operation procedures, quick-look test report

Delivery of Data/DRDs (mo/yr): NLT 30 days before milestone (except as noted below)

Objective: [REDACTED]

- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]

Indicators of Milestone Readiness:

- (a) ECLSS module test unit completed, including all required ECLSS subsystems, such as:
 - (1) CO₂ scrubbing system and fans.

- (2) Oxygen delivery system.
- (3) Dehumidifier system.
- (b) ECLSS module GSE completed.
 - (1) Flight-like avionics interfaces.
 - (2) GSE thermal control systems.
 - (3) GSE oxygen consumables.
 - (4) GSE vacuum system.
- (c) Checkout testing of the ECLSS module completed, including:
 - (1) Leak checks of the pressure section, oxygen system and TCS.
 - (2) Avionics checkouts.
- (d) Final test plan completed and submitted to NASA at least 30 days before the test. The test plan will contain:
 - (1) Primary and secondary (if any) test objectives.
 - (2) Configuration of the test unit.
 - (3) Key differences between test unit and flight unit.
 - (4) Instrumentation plan.
- (e) Test operation procedures released at least 15 days before the test.
- (f) Test readiness review completed at least 7 days before the test.
- (g) ECLSS module and GSE schematics delivered to NASA no later than 30 days prior to the test.

Acceptance Criteria:

- (a) Test results satisfy primary test plan objectives, or a process is in place to disposition any open items.
- (b) Quick-look report provided to NASA within 10 days of the test, including the following information:
 - (1) Plots of predicted versus measured performance of all applicable ECLSS subsystems.
 - (2) Description of major anomalies.
 - (3) Photographic coverage.

Design Certification Review (DCR) Interim Payment Milestone
Flight to ISS without Crew

Amount: \$ [REDACTED]

Planned Start Date and Completion Date (mo/yr): March 2016

Data/Data Requirement Deliverables (DRDs) to be provided: DRD 109 Flight to ISS without Crew Final Test Plan, DRD 209 Postflight Assessment Report

Delivery of Data/DRDs (mo/yr): NLT 30 days before milestone (except as noted below)

Objective: SpaceX will conduct a flight test of the Dragon-Falcon 9 Crew Vehicle without crew after completion of ISS Integration and before Crew Dragon certification. The mission configuration will closely match that of the subsequent Flight to ISS with Crew milestone, which will be the first crewed mission to the ISS. The purpose of this test flight without crew is to provide an early demonstration and risk reduction of the Dragon-Falcon 9, ground segment, and mission operations elements. We will use the data from this flight test to support Crew System certification products, providing mature deliverables informed by flight data.

The key risks mitigated by objectives of this flight test are related to the following:

- Proximity operations.

[REDACTED]

- Gathering engineering data.

[REDACTED]

- Design validation.

[REDACTED]

- Demonstrate propulsive-assisted land landing concept of operations.
- Demonstrate nosecone mechanism.



Indicators of Milestone Readiness:

SpaceX has completed the following:

- (a) Flight Test without Crew Certification Review (FTCR) completed.
- (b) Open issues from FTCR successfully closed.
- (c) Final Dragon-Falcon 9 Crew Vehicle HITL and integrated system testing completed.
- (d) Vehicle level thermal vacuum and acoustic testing of Dragon successfully completed
- (e) All preflight preparations successfully completed.
- (f) DRD 109 Flight to ISS without Crew Final Test Plan submitted to NASA at least 30 days before the launch.
- (g) Flight readiness review (FRR) held no later than 7 days before the test.
- (h) All action items from the flight test readiness review (if any) answered or dispositioned.

Acceptance Criteria:

- (a) Successful launch and on-orbit deployment of the Dragon-Falcon 9 Crew Vehicle.
- (b) Successful docking of Crew Dragon to the ISS.
- (c) Successful departure, entry and landing of Crew Dragon.
- (d) All mission anomalies identified (if any).
- (e) Test results satisfy primary test plan objectives and support the certification plan, or a process is in place to disposition any open items.
- (f) DRD 209 Postflight Assessment Report initially delivered to NASA within 14 days of landing, with the final report delivered within 30 days after landing.
- (g) A plan and schedule have been defined for the resolution of all actions and open items resulting from the postflight findings. All to be determined and to be resolved items are clearly identified with acceptable plans and schedules for their disposition. All open items to be closed by the design certification review (DCR).

Design Certification Review (DCR) Interim Payment Milestone
Parachute Qualification Complete

Amount: \$ [REDACTED]

Planned Start Date and Completion Date (mo/yr): April 2016

Data/Data Requirement Deliverables (DRDs) to be provided: Parachute Qualification Test Plans, quick-look test reports

Delivery of Data/DRDs (mo/yr): NLT 30 days before Milestone (except as noted below)

Objective: SpaceX will conduct a series of tests on the parachute system in nominal and off-nominal configurations, enveloping conditions for abort and nominal entry scenarios. As described in DRD 108 Verification and Validation Plan, these tests will demonstrate that the design and build of the Crew Dragon parachute system meets the intent of Section 4 of JSC-65985, Requirements for Human Spaceflight for the Trailing Deployable Aerodynamic Decelerator (TDAD) System. Complete human-rating of the parachute system will leverage these tests along with additional analysis, inspection and lessons learned from the pad and in-flight abort tests conducted during CCiCap. The Parachute Qualification milestone will be completed after the Flight to ISS without Crew milestone because the latter does not require this level of human-rating for a flight without crew, and any in-flight observations from that test flight can be used to inform the test plan for parachute qualification.

The Dragon parachute system is critical to the safety of crew members during all missions. Its purpose is to stabilize and decelerate the vehicle to an appropriate descent rate for a safe land landing for all mission cases. The system must not only decelerate the Dragon from the extreme velocities of orbital entry, but must also be able to quickly establish aerodynamic control of the vehicle for aborted launches, the strictest of these scenarios being an emergency event at the launch pad. The parachutes make up a sophisticated system subject to many failure modes both known and unknown, high and potentially uncertain loads, and a wide range of initial conditions. As such, multiple tests in a full scale and flight-like configuration are required to demonstrate and observe aspects such as redundancy effectiveness, performance dispersions, and structural integrity.

Indicators of Milestone Readiness:

- (a) NASA approval of Crew Dragon Verification Plan, including testing in support of certification of the Dragon parachute system.
- (b) Full-scale test unit(s) prepared with relevant characteristics (e.g., mass, moment of inertia, and outer mold line) as similar to the flight configuration as possible.
- (c) Any needed approvals for use of air/land space to run each test.
- (d) Test plans completed and submitted to NASA at least 30 days before test. Test plans will contain:

- (1) Primary and secondary (if any) test objectives.
 - (2) Configuration of the test unit.
 - (3) Key differences between test unit and flight unit.
 - (4) Instrumentation plan.
 - (5) Test conditions and environment.
- (e) Test readiness reviews (TRR) completed no later than 7 days before the test.
- (f) All action items from the test reviews (if any) answered or dispositioned.

Acceptance Criteria:

- (a) Complete each physical test of the Dragon parachute system as outlined in the Crew Dragon Verification Plan.
- (b) Test results satisfy primary test plan objectives.
- (c) Quick-look test reports provided to NASA within 10 days of test completion, including the following:
 - (1) Description of major anomalies.
 - (2) Plots of acceleration and angular rates.
 - (3) Photographic and video coverage.

Design Certification Review (DCR) Interim Payment Milestone
Space Suit Qualification Testing Complete

Amount: \$ ■■■■

Planned Start Date and Completion Date (mo/yr): May 2016

Data/Data Requirement Deliverables (DRDs) to be provided: Space Suit Qualification Test Plan, qualification space suit manufacturing work order, quick-look test report

Delivery of Data/DRDs (mo/yr): NLT 30 days before milestone (except as noted below)

Objective: SpaceX will conduct a series of tests on the SpaceX space suit to qualify the design for flight. This testing will support the verification products as outlined in the DRD 108 V&V plan to ensure the suit meets functional and performance requirements, including structural, leakage, acoustic, thermal, and human factors requirements. Crew-in-the-loop (CITL) testing (e.g., vacuum chamber testing) will be performed to verify performance of the suit with a suited subject. This testing will support space suit qualification and demonstrate readiness for the Flight to ISS with Crew.

Space suit qualification will consist of stand-alone and CITL testing to verify suit performance. A qualification suit will be used for testing at various facilities, as required.

Testing will include:

1. Structural pressure testing to verify the ability of the suit to maintain structural integrity with appropriate factors of safety.
2. Leakage testing to verify the suit leak rate.
3. CITL vacuum chamber testing for the full cabin depressurization duration.
4. Performance testing to verify the suit's ability to washout carbon dioxide from the suited subject's oral nasal region.
5. Pressurized and unpressurized mobility testing with a suited subject to demonstrate that the crew can perform required tasks in-flight.
6. Suit donning testing to verify the crew can don their suits without assistance and within the time required to support the SpaceX concept of operations, in a representative 1-g environment.
7. Acoustic testing to verify the acoustic attenuation of the suit helmet.
8. Interface testing to verify the suit interfaces properly with other Dragon hardware, including seats, restraints, and umbilical connections.

Details of the testing will be defined in the Space Suit Qualification Test Plan.

In any instances where evaluations include pressurized suit testing or for any testing that would pose safety hazards to NASA personnel, SpaceX shall submit test plans, procedures and hazard analyses to NASA for approval before the start of testing.

Indicators of Milestone Readiness:

- (a) Qualification suit build completed, including:
 - (1) All suit elements, such as pressure garment, helmet, gloves and boots.
 - (2) Representative suit pressure control hardware.
- (b) Test readiness review held with NASA no less than 7 days before the start of qualification testing. The purpose of the meeting is to determine readiness to begin qualification testing.
- (c) Qualification test plan(s) completed and submitted to NASA at least 30 days before the test readiness review. The test plan(s) will include:
 - (1) Primary and secondary (if any) test objectives.
 - (2) Test description, including test levels and durations (if applicable).
 - (3) Configuration of the suit qualification article.
 - (4) Key differences between the qualification suit and the flight suit.
 - (5) Safety assessments of test setup for all pressurized suit testing or any testing that would pose safety hazards to NASA personnel
- (d) All action items from the test readiness review answered or dispositioned.
- (e) NASA approval to proceed with testing on a test-by-test basis, such that testing can begin for tests NASA has approved.
- (f) Qualification space suit manufacturing work orders delivered to NASA no later than 30 days prior to the test.

Acceptance Criteria:

- (a) All tests identified in the Space Suit Qualification Test Plan completed.
- (b) Test results satisfy primary test plan objectives and support the human certification plan, or a process is in place to disposition any open items.
- (c) Quick-look test report provided to NASA within 10 days of test completion, including the following:
 - (1) Description of major anomalies.
- (d) Summary of test results showing that the design and performance of the suit meets all relevant requirements.

Design Certification Review (DCR) Interim Payment Milestone
Launch Site Operational Readiness Review for Crew

Amount: \$ [REDACTED]

Planned Start Date and Completion Date (mo/yr): June 2016

Data/Data Requirement Deliverables (DRDs) to be provided: Crew Ingress/Egress Demonstration Test Plan, internal design review documentation, launch complex blast damage area assessment, blast pressure wave analysis and survivability assessment, pad operations hazard analyses, system safety requirements verification, demonstration test report

Delivery of Data/DRDs (mo/yr): NLT 30 days before milestone (except as noted below)

Objective: SpaceX will demonstrate the readiness of the launch complex crew ingress/egress system to show that the system meets all CCT-REQ-1130 requirements with acceptable risk. NASA and SpaceX personnel will evaluate the effectiveness of the pad ingress/egress system. All NASA and SpaceX evaluators and subject matter experts will provide comments and feedback. The demonstration will occur at the launch site and will cover all ground systems associated with nominal and emergency crew ingress/egress operations at the launch complex. The demonstration will support the human certification plan and may be split into multiple stages depending on vehicle readiness. For example, the test could be split to use a ground-based capsule simulator to evaluate ingress/egress timing, and a separate test for pad escape via gantry.

Indicators of Milestone Readiness:

- (a) Demonstration test plan developed and submitted to NASA for review at least 30 days before the crew ingress/egress demonstration. This plan will outline the operations to be simulated, the procedures to be used, and the overall timeline of the demonstration.
- (b) Crew ingress/egress demonstration test readiness review completed at least 7 days before test.
- (c) All action items from the demonstration test readiness review (if any) answered or dispositioned.
- (d) Electronic copy of the following technical products made available for NASA review at least 15 days before the review:
 - (1) Updated concept of operations for ground operations, if applicable.
 - (2) Launch complex blast damage area assessment.
 - (3) Blast pressure wave analysis and survivability assessment.
- (e) Successful completion of prerequisite SpaceX internal design reviews and hardware build for:
 - (i) Lightning protection system.

- (ii) Launch complex service structure, including tower, elevator, Crew Dragon access arm and white room.
 - (iii) Crew emergency egress system.
 - (iv) Pad transportation and handling ground support equipment, including transporter-erector.
 - (v) Launch pad communications systems.
 - (vi) Launch control center.
 - (vii) Emergency subsystems, including fire-suppression system and emergency breathing gas.
- (f) Delivery of internal design review documentation to NASA at least 15 days before the review.
- (g) System safety approval for pad operations.
- (i) Pad operations hazard analysis completed and delivered to NASA 15 days before the review.
 - (ii) System safety requirements verification (for ingress/egress ground systems, only) completed and delivered to NASA 15 days before the review.

Acceptance Criteria:

- (a) Crew ingress and egress operations demonstrated to be safe and effective. Emergency pad egress shown to meet all relevant NASA and SpaceX requirements.
- (b) Human factors assessment performed by NASA and/or SpaceX experts.
- (c) Ground system designs for ingress/egress meet requirements at an acceptable level of risk.
- (d) Functionality of overall system successfully verified via demonstration (when available), or otherwise by analysis, test or inspection.
- (e) Operational concept is technically sound and human factors included (where appropriate).
- (f) Certification objectives have been met or a process is in place to disposition any open items.
- (g) Demonstration test report generated and delivered to NASA.

Design Certification Review (DCR) Milestone

Amount: \$ [REDACTED]

Planned Start Date and Completion Date (mo/yr): July 2016

Data/Data Requirement Deliverables (DRDs) to be provided: DRD 002, DRD 103, DRD 109, DRD 110, DRD 111, DRD 112, DRD 113, DRD 203

Delivery of Data/DRDs (mo/yr): NLT 45 days before milestone reference **DRD 101 Milestone Review Plan**

Objective: DCR acceptance criteria shall be met before any crewed test flights.

At a NASA and Contractor co-chaired DCR, the Contractor shall:

- (a) Demonstrate that the Crew Transportation System (CTS) and operations meet all applicable requirements (exceptions must be preapproved by the Commercial Crew Program/ISS Program (CCP/ISSP)), as defined in CCT-REQ-1130, *ISS Crew Transportation and Services Requirements Document*, and SSP 50808, *ISS to Commercial Orbital Transportation Services (COTS) Interface Requirements Document (IRD)* in order to meet the ISS Design Reference Mission (DRM) within CCT-DRM-1110, *CTS DRM*.
- (b) Provide evidence that it has met all applicable requirements (exceptions must be preapproved by the CCP/ISSP) through the implementation of its baselined management and certification plans and processes required in CCT-PLN-1120, *Crew Transportation Technical Management Processes*.
- (c) Demonstrate schedule performance in accordance with the **DRD 002 Integrated Master Plan and Integrated Master Schedule**.
- (d) Define top safety, technical, cost, and schedule risks.

Upon meeting the DCR Acceptance Criteria defined below, NASA will permit the Contractor to proceed to a Flight Test Readiness Review (FTRR).

Indicators of Milestone Readiness:

The Contractor has completed the following and provided to NASA:

- (a) The **DRD 103 Design Certification Review Data Package**.
- (b) The **DRD 112 Certification Data Package** including but not limited to:

- (1) All **DRD 111 Verification Closure Notices (VCNs)** demonstrating that the CTS requirements have been met. (All VCNs shall be closed unless exceptions are preapproved by the CCP/ISSP).
- (2) The hazard analysis and **DRD 110 Hazard Reports** have been approved by NASA.
- (c) All management and certification plans and processes required in CCT-PLN-1120 have been completed.
- (d) ISS Integration per SSP 50964, *Visiting Vehicle ISS Integration Plan*, including the Flight Operations Review and the ISS Phase III Safety Review have been completed. Forward work is scheduled and approved by NASA.
- (e) The **DRD 002 Integrated Master Plan and Integrated Master Schedule**.
- (f) The **DRD 113 Range Safety Data Documentation**.
- (g) The **DRD 203 Vehicle Interface Definition Document (IDD)**.
- (h) An assessment of the top safety risks and documentation of the management and acceptance of risk including, but not limited to:
 - (1) Most recent results of the Probabilistic Safety Analysis (PSA) that identify the integrated safety and mission assurance risk of the baseline design, and individually identifies top risk contributors.
 - (2) An assessment of crew survival capability of the baseline design in accordance with CCT-PLN-1120.
- (i) The top programmatic risks have been identified and assessed.
- (j) Documentation substantiating all Review Item Dispositions (RIDs) and actions from design reviews, verification reviews, and Certification Baseline Review (CBR) are closed.

Acceptance Criteria:

- (a) The **DRD 112 Certification Data Package** has been approved by NASA.
 - (1) All applicable **DRD 111 VCNs** have been approved by NASA. (All VCNs relevant to crewed flight test will be approved by NASA with acceptable open work).
 - (2) The design provides crew survival capability.
 - (3) Operational limits and constraints have been implemented and verified.
 - (4) Operational roles and procedures have been defined for crew, mission team and mission management.

NNK14MA74C - Commercial Crew Transportation Capability (CCtCap) Contract

- (b) An **DRD 002 Integrated Master Plan and Integrated Master Schedule** has been approved.
- (c) The top safety risks are identified, assessed, and clearly communicated. Plans, processes, and appropriate resources necessary to effectively manage the risks are in place.
 - (1) Major risks to crew safety and mission success have been identified, quantified, and integrated in a PSA.
 - (2) Risk mitigation strategies associated with the CTS design baseline, cost and schedule have been identified and agreed upon by NASA.
- (d) The top programmatic risks have been identified. Plans, processes, and appropriate resources necessary to effectively manage the risks are in place.
- (e) All RIDs and actions from design reviews, verification reviews and CBR are closed. All To be Determined (TBD) and To be Resolved (TBR) items are clearly identified with acceptable plans and schedules for their disposition and have been submitted.
- (f) A plan and schedule have been defined for the resolution of all actions and open items resulting from the DCR. All TBD and TBR items are clearly identified with acceptable plans and schedules for their disposition.

Flight Test Readiness Review (FTRR) Interim Milestone

Amount: \$ [REDACTED]

Planned Start Date and Completion Date (mo/yr): September 2016

Data/Data Requirement Deliverables (DRDs) to be provided: DRD 104, DRD 110, DRD 111, DRD 112,

Delivery of Data/DRDs (mo/yr): NLT 45 days before milestone reference **DRD 101 Milestone Review Plan**

Objective: For each crewed flight test(s), the Contractor shall conduct an FTRR that demonstrates readiness to conduct a crewed flight test and defines a risk baseline for crewed flight test activities.

Indicators of Milestone Readiness:

The Contractor has completed the following and provided to NASA:

- (a) All data and documentation identified in CCT-PLN-1120, *Crew Transportation Technical Management Processes*, Appendix F, *CTS FRR Milestone Data*, as the **DRD 104 FTRR Data Package**.
 - (1) Approval of any new, open or changes to applicable **DRD 111 Verification Closure Notices (VCNs)**, **DRD 110 Hazard Reports**, and **DRD 112 Certification Data Package**.
 - (2) Documentation that all acceptance, checkout and integration testing has been completed.
 - (3) Documentation of flight specific products.
 - (4) Documentation that the launch site, Range, recovery and tracking and data support resources have committed to launch.
 - (5) Documentation that landing site recovery support and resources have committed to landing.
 - (6) Documentation that all operational supporting and enabling capabilities (e.g., facilities, equipment, documents, updated databases) necessary for nominal and contingency operations have been tested and delivered/installed at the site(s) necessary to support operations.

- (7) Documentation that plans, processes, procedures and training for nominal and contingency operations for the Crew Transportation System (CTS) have been completed to support operations.
- (8) Documentation that systems hardware, software, personnel, processes and procedures are in place to support operations.
- (b) The Contractor, its subcontractors, suppliers and team members have provided flight readiness endorsements demonstrating that they have met requirements in accordance with the Contractor's management processes.
- (c) International Space Station (ISS) Stage Operational Readiness Review (SORR) has been completed and the ISS is ready to accept the Visiting Vehicle and crew for flight tests to ISS.
 - (1) Documentation of residual mission risks and related analyses for acceptance.
- (d) All open actions from Design Certification review (DCR) and SORR have been closed.

Acceptance Criteria:

- (a) The **DRD 104 FTRR Data Package** has been presented and accepted by NASA.
- (b) All changes, modifications and anomalies since DCR have been resolved and resolutions have been accepted by NASA.
- (c) Mission management team, crew, and mission support team have been identified, have been trained, and are in place.
- (d) The plan and schedule of preplanned forward work has been accepted by NASA.
- (e) Any open work or constraints to launch are identified and closeout plans and schedules are in place and supportable.
- (f) NASA has accepted the flight specific products.
- (g) Launch Site, Range, and recovery support organizations have committed to launch.
- (h) Landing site support and resources have committed to landing.
- (i) NASA has accepted residual flight test risks.

Certification Review (CR) Interim Payment Milestone
Flight to ISS with Crew

Amount: \$ [REDACTED]

Planned Start Date and Completion Date (mo/yr): October 2016

Data/Data Requirement Deliverables (DRDs) to be provided: DRD 109 Flight to ISS with Crew Final Test Plan, DRD 209 Postflight Assessment Report

Delivery of Data/DRDs (mo/yr): NLT 30 days before milestone (except as noted below)

Objective: As the final validation test before proceeding with the Crew Vehicle Operations Readiness Review (ORR), SpaceX will conduct a second test flight of the Dragon-Falcon 9 Crew System, this time with crew, after NASA approval of the Design Certification Review and Flight Test Readiness Review. The purpose of this test is to provide an early demonstration and risk reduction of the Dragon-Falcon 9 System for operational missions. We will use the data from this flight to support the creation of mature Crew Dragon certification products and to demonstrate readiness for post-certification missions. This flight test will be a short-duration mission of approximately 14 days.

The key risks mitigated by this flight test are related to the following CITL operations:

- Proximity operations.
 - Proximity operations with the new Dragon-to-ISS communications system.
 - Autonomous V-bar approach and rendezvous.
 - Crew monitoring capability during autonomous docking operations.
 - Crew ingress and egress to ISS.
- Gathering engineering data gathering.
 - Additional data for thermal model validation.
 - Additional aerodynamic data for modified Dragon OML during entry and landing.
 - Additional flight data for loads and dynamic environments.
 - Data for ECLSS performance with crew onboard during all phases of flight.
- Design validation.
 - Crew manual control of vehicle attitude and translation.
 - Nominal operation of spacesuits.
 - The ability of the crew to adequately monitor vehicle performance and command vehicle systems.

Indicators of Milestone Readiness:

SpaceX has met the following criteria:

- (a) Design Certification Review (DCR) completed.
- (b) Open issues from the Flight Test Readiness Review successfully closed.
- (c) Received FAA, Range Safety and/or other applicable government approvals for the test demonstration.
- (d) Final Dragon-Falcon 9 Crew Vehicle HITL and integrated system testing completed.
- (e) All preflight preparations successfully completed.
- (f) All crew and ground operator training completed and all personnel certified for flight.
- (g) DRD 109 final flight test plan submitted to NASA at least 30 days before the launch. NASA comments on the test plan provided to SpaceX no less than 15 days before launch.

Acceptance Criteria:

- (a) Successful launch and on-orbit deployment of the Dragon-Falcon 9 Crew Vehicle.
- (b) Successful docking of the Crew Dragon system to the ISS.
- (c) Successful ingress of the crew to ISS.
- (d) Successful departure, entry and landing of Crew Dragon.
- (e) Successful demonstration of crew manual flight control, crew commanding and crew monitoring functions.
- (f) Safe return of crew to Earth.
- (g) All mission anomalies identified (if any).
- (h) Test results satisfy primary test plan objectives and support the certification plan, or a process is in place to disposition any open items.
- (i) DRD 209 Postflight Assessment Report delivered to NASA within 14 days of landing, the final report delivered within 30 days after landing.
- (j) A plan and schedule have been defined for the resolution of all actions and open items resulting from the postflight findings. All to be determined and to be resolved items are clearly identified with acceptable plans and schedules for their disposition. All open items to be closed by the Operational Readiness Review (ORR).

Operations Readiness Review (ORR) Interim Milestone

Amount: \$ [REDACTED]

Planned Start Date and Completion Date (mo/yr): January 2017

Data/Data Requirement Deliverables (DRDs) to be provided: DRD 105, DRD 110, DRD 111, DRD 112,

Delivery of Data/DRDs (mo/yr): NLT 45 days before milestone reference **DRD 101 Milestone Review Plan**

Objective: At a NASA and Contractor co-chaired Operations Readiness Review (ORR), the Contractor shall demonstrate that the actual Crew Transportation System (CTS) system characteristics and the procedures used in operations reflect the deployed state of the CTS. The ORR evaluates all project and support (flight and ground) hardware, software, personnel, and procedures to ensure flight and associated ground systems are in compliance with program requirements and constraints.

An ORR occurs upon successful completion of the crewed test flight to International Space Station (ISS). Upon meeting the ORR Acceptance Criteria defined below, NASA will accept operations readiness of the system for Post Certification Missions (PCMs).

Indicators of Milestone Readiness:

The Contractor has completed the following and provided to NASA:

- (a) The **DRD 105 Operations Readiness Review (ORR) Data Package.**
- (b) Any updates to the **DRD 112 Certification Data Package.**
- (c) Any new, open or changed **DRD 111 Verification Closure Notices (VCNs)** and **DRD 110 Hazard Reports.**
- (d) Approval of closure of action items from Flight Test Readiness Review(s) (FTRR(s)), Design Certification Review(s) (DCR(s)) and previous reviews.
- (e) Documentation substantiating that all validation testing has been completed.
- (f) Documentation providing evidence that failures and anomalies have been resolved and the results incorporated.
- (g) Documentation that all operational supporting and enabling capabilities (e.g., facilities, equipment, documents, updated databases) necessary for nominal and contingency

operations have been tested and delivered/installed at the site(s) necessary to support recurring operations.

- (h) Documentation that plans, procedures and training for nominal and contingency operations for the CTS have been completed to support recurring operations.
- (i) Documentation that systems hardware, software, personnel, and procedures are in place to support recurring operations.
- (j) An assessment of the top safety risks and documentation of the management and acceptance of risk including but not limited to:
 - (1) Most recent results of the Probabilistic Safety Analysis (PSA) that identify the integrated safety and mission assurance risk of the baseline design, and individually identifies top risk contributors.
 - (2) An assessment of crew survival capability of the baseline design in accordance with CCT-PLN-1120, *Crew Transportation Technical Management Processes*.
- (k) The top programmatic risks have been identified and assessed.
- (l) Documentation substantiating all Review Item Dispositions (RIDs) and actions from design reviews, verification reviews, DCR(s), and FTRR(s) are closed.

Acceptance Criteria:

- (a) The CTS, including any enabling products, is determined to be ready to be placed in a recurring operations status.
 - (1) NASA has approved the updated **DRD 112 Certification Data Package** including any remaining open **DRD 111 Verification Closure Notices** and **DRD 110 Hazard Reports**.
 - (2) NASA has approved closure of action items from DCR and previous reviews.
 - (3) NASA has accepted documentation as evidence that all validation testing has been completed.
 - (4) NASA has accepted documentation as evidence that failures and anomalies have been resolved and the results incorporated.
 - (5) NASA has accepted documentation that all operational supporting and enabling capabilities (e.g., facilities, equipment, documents, updated databases) necessary for nominal and contingency operations have been tested and delivered/installed at the site(s) necessary to support sustaining operations.

- (6) NASA has accepted documentation that all plans, procedures and training for nominal and contingency operations for the CTS have been completed to support sustaining operations.
- (b) NASA has accepted documentation that systems hardware, software, personnel, and procedures are in place to support operations.
- (c) The top safety risks for Post Certification Missions are identified, assessed, and clearly communicated. Plans, processes, and appropriate resources necessary to effectively manage the risks are in place.
 - (1) Major risks to crew safety and mission success have been identified, quantified, and integrated in a PSA.
 - (2) Risk mitigation strategies associated with the CTS design baseline, cost and schedule have been identified and agreed upon by NASA.
- (d) The top programmatic risks have been identified. Plans, processes, and appropriate resources necessary to effectively manage the risks are in place.
- (e) A plan and schedule have been defined for the resolution of all actions and open items resulting from the ORR. All To be Determined (TBD) and To be Resolved (TBR) items are clearly identified with acceptable plans and schedules for their disposition.

Certification Review (CR) Milestone

Amount: \$ [REDACTED]

Planned Start Date and Completion Date (mo/yr): April 2017

Data/Data Requirement Deliverables (DRDs) to be provided: DRD 106, DRD 111, DRD 112,

Delivery of Data/DRDs (mo/yr): NLT 45 days before milestone reference **DRD 101 Milestone Review Plan**

Objective: At a NASA chaired review, the Contractor shall provide evidence that the CTS has met all NASA requirements identified in Attachment J-01, *Integrated Crew Transportation System (CTS) Requirements*. The Contractor shall also provide documentation of the crew safety and mission assurance risks associated with the CTS.

Indicators of Milestone Readiness:

The Contractor has completed the following and provided to NASA:

- (a) The **DRD 106 Certification Review Milestone Data Package**
- (b) The **DRD 112 Certification Data Package.**
- (c) Documentation of results from all flight tests, Operations Readiness Review (ORR), production acceptance testing and closure of any open requirements from Design Certification Review(s) (DCR(s)).
- (d) An assessment of the top safety risks and documentation of the management and acceptance of risk including but not limited to:
 - (1) Most recent results of the Probabilistic Safety Analysis (PSA) that identify the integrated safety and mission assurance risk of the baseline design, and individually identifies top risk contributors.
 - (2) An assessment of crew survival capability of the baseline design.
- (e) The top programmatic risks have been identified and assessed.
- (f) Documentation substantiating all Review Item Dispositions (RIDs) and actions from design reviews, verification reviews, DCR(s), Flight Test Readiness Review(s) (FTRR(s)) and ORR are closed.

Acceptance Criteria:

- (a) CTS Certification recommendation has been approved including **DRD 112 Certification Data Package**.
- (b) Results from risk assessment have been accepted by NASA.
- (c) Closure of all open actions from previous reviews have been approved by NASA.