

CCiCap Announcement Summary Portfolio

Philip McAlister
Director, Commercial Spaceflight
NASA Headquarters

Commercial Spaceflight Status



- SpaceX completed its final COTS Demonstration Mission on May 31, 2012. Regular cargo transportation missions to the ISS are planned to begin later this year.
- Orbital Sciences' initial test flight of the Antares launch vehicle is also scheduled for later this year. Regular cargo transportation missions to the ISS are planned to begin early next year.
- Commercial Crew Development Round 2 (CCDev2) has been very successful to date in advancing commercial crew space transportation system concepts.
 - 7 total partners (4 funded and 3 unfunded)
 - 6 of 62 milestones (in total) left to be completed
 - Several of the Space Act Agreements have been concluded
 - All should be complete by the end of the year



SpaceX Dragon capsule attached to the International Space Station



Orbital Sciences test of Antares hardware at Wallops Flight Facility



Various flight hardware and tests of CCDev2 funded partners

Summary of CCIAP Portfolio



- Diversity of spacecraft types and launch vehicles
 - Two basic types of Spacecraft
 - Capsules and Lifting Body
 - Two different Launch Vehicles
 - Falcon 9 and Atlas V
- The portfolio of companies maintains competition for future phases of the program which should produce “best value” for the government
- Significant progress planned for the base period with analysis, integrated design, development, and hardware testing
- Total set of milestones provide insight into the cost and schedule required to achieve a crewed demonstration flight to low Earth orbit

Sierra Nevada Corporation



➤ Descriptions & Features

- Dream Chaser spacecraft is a reusable, piloted, lifting body, derived from NASA HL-20 concept
 - Carries up to 7 crew members
 - Utilizes non-toxic propellants
 - Primary Launch Site: Cape Canaveral, Florida
 - Primary Landing Site: Shuttle Landing Facility, Florida
 - Abort scenario leverages primary propulsion system with an ability to abort to a runway landing
- Atlas V vehicle launched from the Space Launch Complex 41 launch pad

➤ Base Period

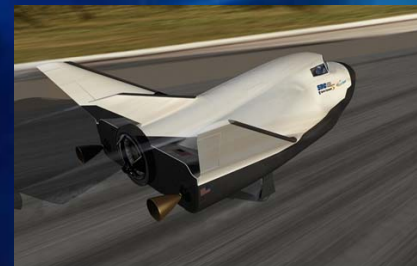
- \$212.5M total NASA funding for 9 milestones
- Significant progress toward completion of critical design
- Two major safety reviews and significant subsystem technology maturation and hardware testing



Artist rendition of Dream Chaser in low-Earth orbit



Artist rendition of Dream Chaser and Atlas V on launch pad



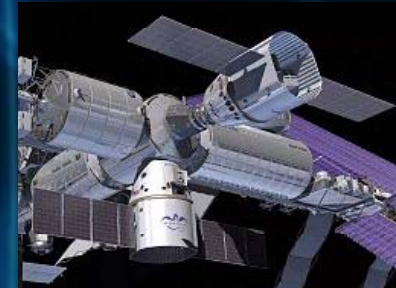
Artist rendition of Dream Chaser landing on a runway

Space Exploration Technologies Corporation



➤ Descriptions & Features

- Spacecraft uses a crewed version of the SpaceX Dragon capsule
 - Carries up to 7 Crew
 - Primary Launch Site: Cape Canaveral, Florida
 - Primary Landing Site: “On land” landing, specific landing site in work
 - Integrated, side-mounted launch abort system utilizing SuperDraco engines
- Upgraded Falcon 9 vehicle launched from the Space Launch Complex 40 launch pad
- Mid calendar year 2015 crewed test flight (dependent on funding and technical progress)



Artist rendition of Dragon attached to ISS

➤ Base Period

- \$440M total NASA funding for 14 milestones
- Culminates in an integrated critical design review milestone
- Includes a pad abort test and an in-flight abort test



Picture of Falcon 9 rocket on launch pad in Florida



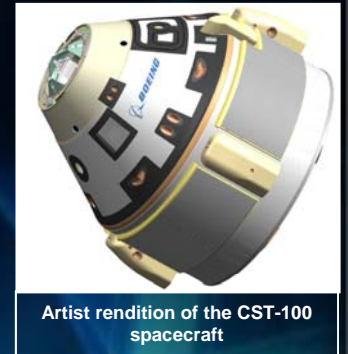
Artist rendition of Dragon re-entering Earth's atmosphere

The Boeing Company



➤ Descriptions & Features

- CST-100 spacecraft is a reusable capsule design utilizing many proven flight components
 - Carries up to 7 people
 - Primary Launch Site: Cape Canaveral, Florida
 - Primary Landing Site: “On Land” landing, specific landing site in work
 - “Pusher” launch abort system
- Atlas V launch vehicle using the dual engine Centaur upper stage configuration and launched from the Space Launch Complex 41 launch pad
- Late calendar year 2016 crewed test flight (dependent on funding and technical progress)



Artist rendition of the CST-100 spacecraft

➤ Base period

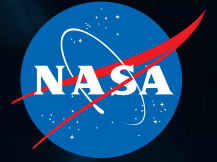
- \$460M total NASA funding for 19 milestones
- Culminates in an integrated critical design review milestone
- Significant propulsion system, avionics, and wind tunnel development and testing



Artist rendition of CST-100 and Atlas V on the launch pad



Successful parachute drop test accomplished during CCDev2



CCiCap Announcement Summary Base Period Content

Brent Jett
Deputy Manager
Commercial Crew Program

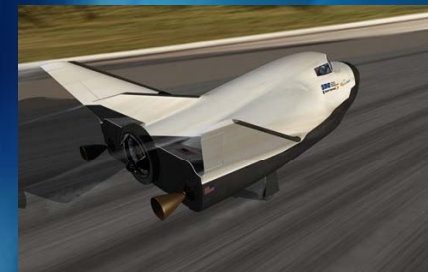
Sierra Nevada Corporation



➤ Base Period Details (Key Milestones)

- Design and Development:
 - ♦ Program Implementation
 - ♦ Integrated System Baseline Review
 - ♦ Two Integrated System Safety Analysis
 - ♦ Certification Plan

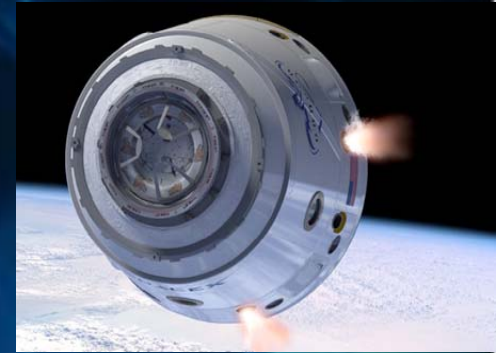
- Testing:
 - ♦ Engineering Test Article Flight(s)
 - ♦ Wind Tunnel Risk Reduction
 - ♦ Spacecraft Subsystem Risk Reduction
 - ♦ Main Propulsion Risk Reduction
 - ♦ Reaction Control System Risk Reduction



Space Exploration Technologies



- **Base Period Details (Key Milestones)**
- - Design and Development:
 - Integrated System Requirements Review
 - Ground Systems & Ascent Preliminary Design Review
 - Test Reviews for Pad Abort & In-Flight Abort
 - Human Certification Plan Review
 - On-Orbit & Entry Preliminary Design Review
 - Safety Review
 - Flight Review of Upgraded Falcon 9
 - Integrated Critical Design Review
 - Testing:
 - Dragon Primary Structure Qualification
 - Flight tests:
 - Pad Abort (SLC 40 and last quarter of 2013)
 - In-Flight Abort (SLC 40 and 2nd quarter of 2014)



The Boeing Company



➤ Base Period Details (Key Milestones)

- Design and Development:
 - ♦ Integrated System Review
 - ♦ Production Design
 - ♦ Phase 1 Safety Review Board
 - ♦ Landing & Recovery / Ground Communication Design
 - ♦ Launch Vehicle Adapter Design
 - ♦ Certification Plan Review
 - ♦ SW Critical Design Review
 - ♦ System Critical Design Review

- Testing:
 - ♦ Integrated Stack Force & Moment Wind Tunnel
 - ♦ Dual Engine Centaur Development
 - ♦ Orbital Maneuvering & Attitude Control Engine Development
 - ♦ Mission Control Center Interface Demonstration
 - ♦ Emergency Detection System Standalone
 - ♦ Avionics SW Integration Lab Multi-String Demonstration
 - ♦ Pilot-in-the-Loop Demonstration



Boeing CCIcap Milestone Summary



Boeing



Legend

- # Test
- △ Review
- Base

FY12			FY13			FY14			FY15			FY16			FY17			FY18																													
O	N	D	J	F	M	O	N	D	J	F	M	O	N	D	J	F	M	O	N	D	J	F	M	O	N	D	J	F	M	O	N	D	J	F	M	O	N	D	J	F	M						
					1																																										
					△																																										
					Integrated System Review																																										
					2																																										
					Production Design Review																																										
					3																																										
					Phase 1 Safety Review Board																																										
					4																																										
					Software Integrated Engineering Release 2.0																																										
					5																																										
					Landing and Recovery / Ground Communication Design Review																																										
					6																																										
					Launch Vehicle Adapter (LVA) Preliminary Design Review (PDR)																																										
					7																																										
					Integrated Stack Force and Moment Wind Tunnel Test																																										
					8																																										
					Dual Engine Centaur (DEC) Liquid Oxygen Duct Development Test																																										
					9																																										
					Orbital Maneuvering and Attitude Control (OMAC) Engine Development Test																																										
					10																																										
					Spacecraft Primary Structures Critical Design Review (CDR)																																										
					11																																										
					Service Module Propulsion System Critical Design Review (CDR)																																										
					12																																										
					Mission Control Center Interface Demonstration Test																																										
					13																																										
					Launch Vehicle Adapter Critical Design Review (CDR)																																										
					14																																										
					Landing and Recovery / Ground Communication Design Review																																										
					15																																										
					Emergency Detection System (EDS) Standalone Testing																																										
					16																																										
					Avionics Software Integration Lab (ASIL) Multi-String Demonstration Test																																										
					17																																										
					Pilot-in-the-loop Demonstration																																										
					18																																										
					Software Critical Design Review (CDR)																																										
					19																																										
					Critical Design Review (CDR) Board																																										

