



Commercial Crew Program Status

NAC
Commercial Space Committee

Ed Mango



Commercial Crew Program

September 18, 2012

Commercial Crew Program Objectives



Commercial LEO Capability

❖ Public Purpose

- Competed, funded SAAs to advance industry CTS capabilities

ISS Design Reference Mission

❖ NASA Need

- NASA certification contracts
- ISS services contract





CCiCap Overview

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

Artist rendition of Dream Chaser in low-Earth orbit



Artist rendition of Dream Chaser and Atlas V on 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 landing on a runway





❖ 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 Corporation (SpaceX)



❖ Descriptions & Features

- Spacecraft uses a crewed version of the SpaceX Dragon capsule
 - Carries up to 7 crew members
 - 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



Artist rendition of Dragon re-entering Earth's atmosphere

❖ 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





❖ 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



❖ Descriptions & Features

- CST-100 spacecraft is a reusable capsule design utilizing many proven flight components
 - Carries up to 7 crew members
 - 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

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

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ISS Design Reference Mission

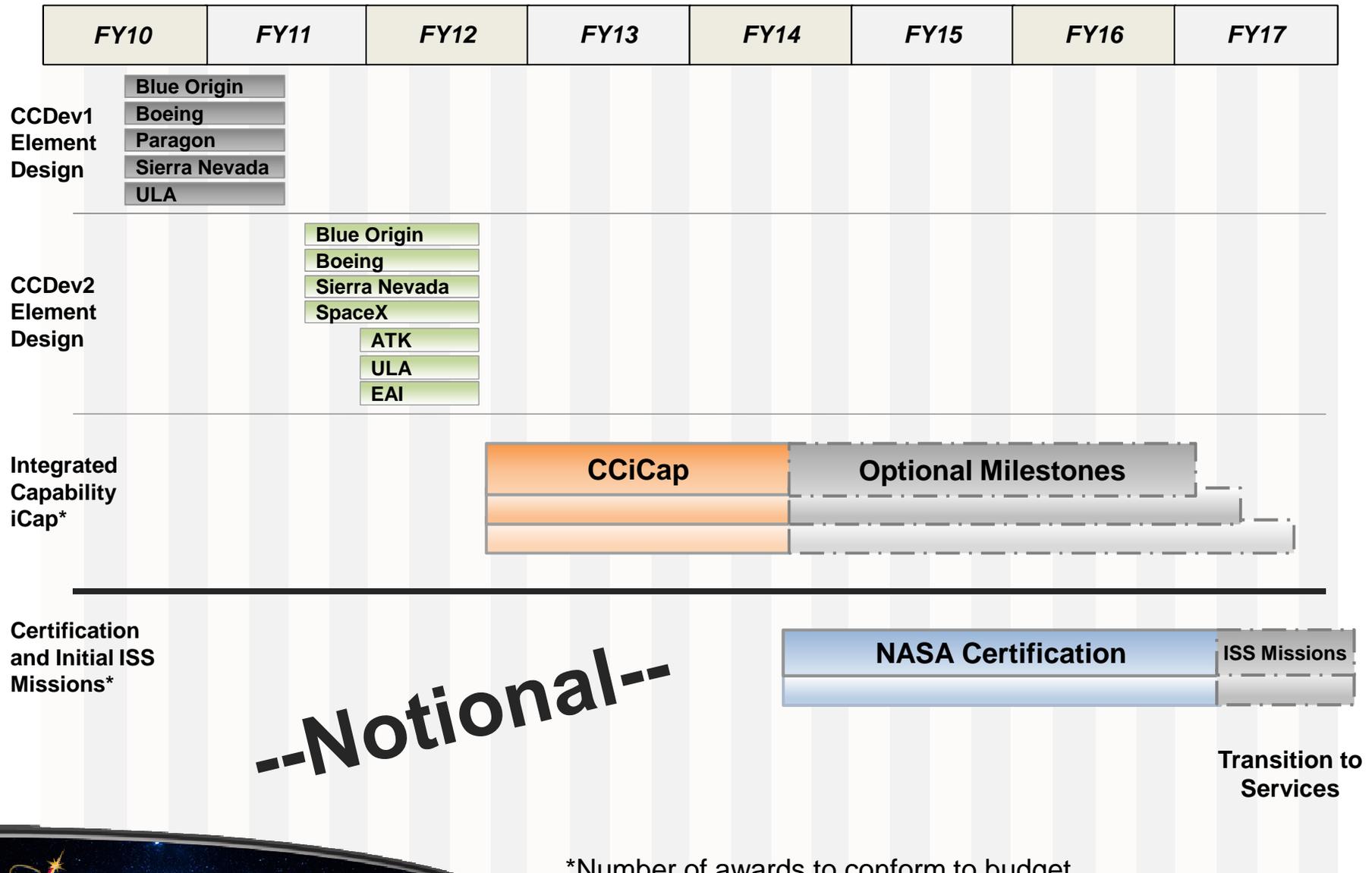
❖ NASA Need

- NASA certification contracts
- ISS services contract



NASA/ISS Certification Overview

Presented at Program Forum in February 2012



--Notional--

Transition to
Services

*Number of awards to conform to budget



Revised Acquisition Strategy (2012)

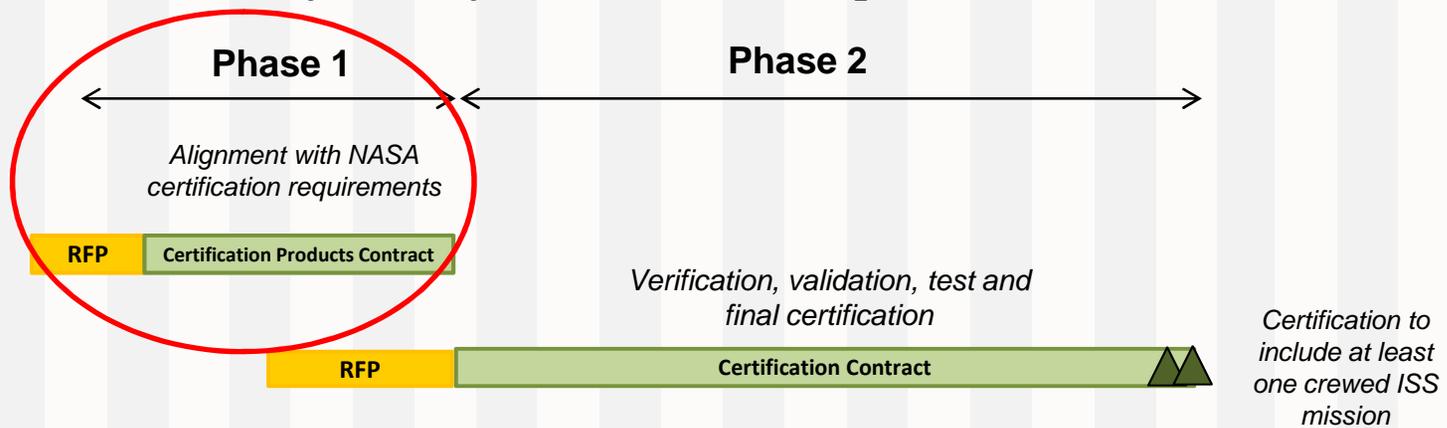


FY12	FY13	FY14	FY15	FY16	FY17	FY18

Commercial Crew Transportation System Development



Certification for ISS Crew Transportation



Notional ISS Crew Transportation Services



Phase 1 – Certification Products Contracts (CPC)



- ❖ Contract Objective - Begin early, critical certification work to meet NASA Crew Transportation System (CTS) requirements
 - Maturing key certification products in Phase 1 enables industry readiness and level of maturity required for NASA evaluation of Phase 2
 - Allows technical interchanges between NASA and contractors on certification requirements
 - Alternate Standards
 - Hazard Analyses/Reports
 - Verification & Validation Plan
 - Certification Plan
 - Begin the process of ISS visiting vehicle integration
 - No design/development work funded through CPC
 - Increases confidence in ISS services date



Phase 2 – Certification Contract

- ❖ Contract Objective – Enabling NASA to assess and approve the CTS capability to perform the NASA ISS DRM
- ❖ Completion of key products required for the NASA crewed mission to the ISS
 - Ensure NASA mission and safety objectives are achieved
 - Activities include:
 - Development
 - Test
 - Evaluation
 - Certification
 - Options may include a nominal number of crewed missions to the ISS following successful CTS Certification
 - Phase 2 activities will lead to a competitive acquisition for commercial ISS transportation services using a FAR-based fixed price contract

