# Commercial Programs

NASA Advisory Committee Meeting

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# Commercial Crew Program (CCP) Status

# CCP Flight Accomplishments

## CCP is proud to be a new chapter in human spaceflight


SPACEX

**Demo-1**
Launched 03/02/19
Landed 03/08/19


BOEING

**OFT**
Launched 12/20/19
Landed 12/22/19


SPACEX

**Demo-2**
Launched 05/30/20
Landed 08/02/20

SPACEX

**Crew 1**
Launched 11/15/20
Landed 05/02/21

SPACEX

**Crew 2**
Launched 04/23/21
Landed 11/09/21

SPACEX

**Crew 3**
Launched 11/10/21
Landed 05/06/22

SPACEX

**Crew 4**
Launched 04/27/22
Landed 10/14/22


BOEING

**OFT-2**
Launched 05/19/22
Landed 05/25/22

SPACEX

**Crew 5**
Launched 10/5/22
Landed 3/12/23

SPACEX

**Crew 6**
Launched 3/2/23
On orbit

# Commercial Crew Program Summary

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| G | On plan, adequate margin | Y | Issues, working to resolve within planned margin | R | Issues, not enough margin to recover | Trend | ↓ | Unfavorable | ↑ | Favorable | → Unchanged |

| Technical | | | Cost | | | Schedule | | | Programmatic | | | Overall | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Previous | Current | Trend | Previous | Current | Trend | Previous | Current | Trend | Previous | Current | Trend | Previous | Current | Trend |
| Y | Y | → | G | G | → | Y | G | ↑ | G | G | → | Y | Y | → |

## MAJOR CHANGES

- SpaceX Crew-6 launched on March 2, 2023 and docked to ISS on March 3, 2023
- SpaceX Crew-5 landed on March 12, 2023
- Boeing Crew Flight Test (CFT) scheduled to launch NET July 21, 2023
- CCP and Comm LEO Program beginning more robust engagement

## TECHNICAL PERFORMANCE — YELLOW

- SpaceX Crew-7 ops progressing nominally
- Boeing has made significant progress on CFT hardware processing
- Various technical issues are open for CFT, but closure plans on schedule

## SCHEDULE PERFORMANCE — GREEN

- SpaceX Crew-5 landed on March 12, 2023
- SpaceX Crew-6 launched on March 2, 2023
- Boeing CFT launch now scheduled to launch NET July 21, 2023
- Assuming internal work-to dates are met, sufficient schedule margin exists to assure continuous ISS crew presence via SpaceX supporting back-to-back operational missions

## COST PERFORMANCE — GREEN

- CCtcap contracts are firm fixed price, which has minimized cost overrun risk
- Contract cost performance is progressing according to plan
- Positive UFE balance due to retired COVID threats in Feb. 2023

## PROGRAMMATIC PERFORMANCE — GREEN

- CCP is continuing to deliver on safe, reliable and cost-effective transportation to ISS through partnership with private industry
- Boeing is making progress toward crewed test flight and certification
- SpaceX continuing to provide crewed missions to the ISS
- CCP has robust and efficient processes for certification including addressing any necessary waivers and deviations

# Crew-5 Status and Crew-6/Crew-7 Readiness

## Crew-5 Status

- Launched on October 5, 2022
- Docked to ISS on October 6, 2022
- Landed  March 12, 2023
- Crew-5 crew maintained nominal on-orbit operations
- Downhill reviews in work

## Crew-6 Readiness

- Launched March 2, 2023
- Docked duration up to six months
- Return following a short handover with Crew-7

- Dragon Status (206-4, *Endeavour*)
- Falcon Status (Stage One: B1078-1, Stage Two: 2211)

- Crew-6 Endeavour vehicle and crew continue nominal on-orbit operations
- Post flight reviews in work

## Crew-7 Readiness

- Planned launched  NET mid August 2023
- Docked duration up to six months
- Crew-7 product closure list in work; metric scorecard pending

# Crew Flight Test (CFT) Status


- Crew: Barry “Butch” Wilmore, Suni Williams
  - Launch Vehicle: Atlas V
  - Starliner: Spacecraft 3 Calypso, previously flew OFT-1
- Boeing Crew Flight Test targeted for launch NET July 21, 2023
- Boeing has made significant progress on CFT hardware processing
- Certification products continue to be a pacing item
  - Over 90% of Certification products are complete
  - Most remaining Certification products are planned to close by end of May
  - Long pole Certification product completion is Parachute Verification Closure Notice and Hazard Reports
  - Results from ongoing testing could potentially drive additional effort prior to CFT and/or Certification

- First American-made orbital crew capsule to land on land with crew
- First launch of crew from Cape Canaveral since 1968 (Apollo 7)

# CCP Contract Cost Performance

- Cost performance of the CCtCap contracts with Boeing and SpaceX has been very good. Maximum Value Percentage Growth average is 6.7%, which is under the CCP GAO contract growth reporting metric of 15%.
- The SpaceX contract mods for Crew 7-14 are excluded from the cost growth metric.
- Positive Unfunded Future Expenses (i.e., reserves) balance should be sufficient for the rest of the fiscal year.

# Commercial LEO Development Program Status

# ISS-to-CLD Transition

| 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 |
|---|---|---|---|---|---|---|---|---|---|---|---|

Goal for CLD Initial Capability ▲ Planned ISS Deorbit ▼

International Space Station (ISS) Operations → CLD Operations

Transition Period

## CLD Phase 1: Design Maturation

**Commercial Destinations for ISS (CDISS)**
*Axiom Space*

*2-year Option*

**Commercial Destinations Free Flyer (CDFF)**
*Blue Origin & Sierra Space Orbital Reef*

**Commercial Destinations Free Flyer (CDFF)**
*Nanoracks & Voyager Space Starlab*

**Commercial Destinations Free Flyer (CDFF)**
*Northrop Grumman's Commercial Space Station*

## CLD Phase 2: Certification and Services

**NASA Certification of CLD(s) and Purchase Services**
*Full and open competition, one or more awards*

# Comm LEO Program Accomplishments

- FY23 was second straight year of full funding for the program, and it more than doubled from the FY22 budget ($224M, up from $102M)
- The first Private Astronaut Mission successfully completed and two more in work
- Over a dozen development milestones completed by Commercial LEO Destination (CLD) partners
- Three program documents released via RFIs
- Awarded two SBIR contracts related to Commercial LEO
- Released an Announcement for Proposals for no-exchange-of-funds Space Act Agreements focused on Comm LEO capabilities (Collaborations for Commercial Space Capabilities-2)

# Comm LEO Program Upcoming Milestones

- Execute second and third Private Astronaut Missions to the ISS
- Continue to facilitate progress on CLD development efforts (Axiom, Blue Origin, Nanoracks, Northrop Grumman)
- Release initial set of CLD Requirements (Destination, Crew, Cargo, and Utilization)
- Refine CLD Certification Strategy
- Begin Office of Technology Policy and Strategy-led study of CLD insurance and liability options
- Award CCSC-2 agreements

# International Partnerships in Post-ISS LEO

- NASA and ISS international partners have been meeting to discuss future LEO activities and potential cooperation arrangements
- Key NASA policy decisions:
  - International space agencies are welcome to make direct partnering agreements with CLD providers
  - NASA will be pursuing partnerships with international space agencies for joint science/utilization activities onboard CLDs
  - NASA is open to cooperation with international space agencies on cargo and/or crew transportation capabilities to support CLD activities and facilitate future LEO flight opportunities. Such flight opportunities are envisioned to be additive to NASA's requirement of 2 crew continuously on orbit.
  - NASA does NOT intend to provide LEO services to foreign governments or space agencies for the provision of CLD infrastructure

# Suborbital Crew (SubC) Status

# Suborbital Crew Program

- SubC continues to engage Blue Origin and Virgin Galactic in an innovative “Safety Case” approach to meet Agency objectives
  - These objectives include expanding acceptable platforms available to Civil Servants to support human-tended research in microgravity
  - Partnering with the FAA on lessons learr ed and capabilities to ensure a streamlined transition to regulation of passenger safety in space
  - Fostering the development of commercial space through technical insight, engagement, and advocacy for safe and reliable systems
- SubC Safety Case approach utilizes an evidenced-based paradigm without specific direction or requirements
  - Safety Case strategy includes comprehensive look at safety by focusing on design and operational standards, processes and procedures coupled with targeted “deep dives” into traditionally high-risk areas
  - Insight into Provider design standards, processes and procedures
  - Utilizes industry tools (PRAs, Hazard Controls, etc.) to identify and mitigate risk contributors
  - Multiple U.S. organizations, including NASA, major aerospace companies, DoD weapon systems and civil/commercial aircraft are already embracing the Safety Case approach

# Suborbital Crew Program Status

- SubC leverages experience base of Commercial Crew and Flight Worthiness Process at Armstrong Flight Research Center

- Blue Origin deep dives include
  - Escape System (wrapping up)
  - Propulsion System (on going)
  - Parachute System

- Virgin Galatic deep dives include
  - Propulsion system (on going)
  - Mechanisms
  - Operations

Safety Case evaluation of both potential providers on track to be completed in first quarter of 2024

# Challenges

- Ensuring that we (NASA, SpaceX, and Boeing) continue to safely fly crew to/from the ISS.
- Ensuring there is no “gap” in U.S. human presence in LEO.
- While Commercial Cargo and Crew development programs represented huge paradigm changes for the Agency, Commercial LEO Destinations and Suborbital Crew represent equally large changes in the way NASA does business.
- The Agency is embracing less traditional development strategies with a variety of acquisition and partnering strategies.  While this movement is positive, it comes with risks.

# Summary

- CCP is delivering on its goal of safe, reliable and cost-effective transportation to and from ISS from the United States through a partnership with American private industry
- The Comm LEO Program continues to make good progress on development milestones, program requirements, and certification strategy.
- SubC represents a potential significant innovation for human spaceflight systems.