

Dr. Rajiv Doreswamy

Exploration and Transportation
Development Office
Manager
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National Aeronautics and
Space Administration



COMMERCIAL CREW



COMMERCIAL CREW GOAL

A successful commercial human space transportation system will fortify the International Space Station, allow NASA to focus on its Moon mission, reduce the cost of access to space and significantly contribute to the world's economy.

CCP's NASA Purpose

Safe transportation of NASA and NASA-sponsored astronauts to and from the international space station

CCP's Public Purpose

Support the development of non-NASA markets for commercial human transport to and from low-Earth orbit



COMMERCIAL CREW APPROACH

Unique Government-Industry Model

- Defined goal: **end-to-end** transportation solution to ISS
- Clearly stated **safety** requirements
- **Competitive selection** of flight service providers
- **Firm-fixed price** contracts
- **Milestone-based** agreements that support competition, development, testing and demonstration of spaceflight systems
- **Range** of launch vehicle and spacecraft combinations
- Commercial **industry investment**



PARTNERSHIP

Commercial and Contracting Relationships

SpaceX

Spacecraft
Crew Dragon

Launch Vehicle
Falcon 9

Launch Pad
Launch Complex
39A

Landing
Atlantic Ocean



Boeing/ULA

Spacecraft
CST-100 Starliner

Launch Vehicle
ULA Atlas V

Launch Pad
Space Launch Complex
41

Landing
Western United States



Local Contractors

- United Launch Alliance (Decatur, AL)
- Jacobs Engineering Group (with 14+ local subcontractors) (Huntsville, AL)
- Manufacturing Technical Solutions, Inc (Huntsville, AL)
- Kord Technologies, Inc (Huntsville, AL)
- Bastion Technologies (Huntsville, AL)
- Aerie Aerospace LLC (Huntsville, AL)

COMMERCIAL CREW COLLABORATE

Inter-Agency Support of Commercial Spaceflight

Federal Aviation Administration (FAA) and Department of Commerce (DOC)

- “Government Astronaut” classification
- Third-party indemnification
- Mission licensing: launch, re-entry, launch site and operator
- Public health and safety protections
- Jurisdiction and authority during different phases of flight
- Cross waivers for government payloads/property

Department of Defense (DoD)

- Launch and Entry Steering Group
- Synergizing certification efforts

United States Air Force (USAF)

- Strengthening a common fleet

Federal Communications Commission (FCC) & National Telecommunications and Information Administration (NTIA)

- Ensure secure communication pathway availability
- Spectrum usage and authorization

National Transportation and Safety Board (NTSB)

- Independent investigation authority



COMMERCIAL CREW EXPERTISE



- **Veteran astronauts** work directly with Boeing and SpaceX as part of a joint team
- Provide human in-the-loop understanding and **insight**
- Share **best practices**
- Offer **advice** based on previous experience with a variety of spacecraft and launch vehicles
- **Certification** of space transportation system for human spaceflight
- Help prepare for both test flights and **operational missions**



Marshall Space Flight Center (MSFC) Contributions to CCP



Program Overview



Program / Project: Commercial Crew Program (CCP) / Launch Vehicle Systems Office (LVSO)

CCP	
Program Manager	Steve Stich
KSC Deputy	Dana Hutcherson
JSC Deputy	

LVSO	
Manager	Mike Ravenscroft
KSC Deputy	
MSFC Deputy	Steve Gaddis

Center Participants:

- Kennedy Space Center (KSC) – Lead Center
- Johnson Space Center (JSC) – Co-Lead
- Marshall Space Flight Center (MSFC)

MSFC/HEDO Role:

- Provide leadership and support in the areas of LVSO systems, propulsion, integrated performance, and ECLSS
- Implement new model of operation within the Agency, influence culture change
 - Shared Accountability and Shared Assurance

MSFC Contributors:

- HP: Program/Project Management, Systems Leads, Program Planning & Control
- EE: Chief Engineer
- EM: Materials & Processes, Fracture Control
- ER: Liquid & Solid Propulsion, Valve-Actuator-Ducts, CFD, Thermal Analysis, Dynamics
- ES: EMI/EMC, Electrical power, EEE parts,
- EV: SE&I, Structures, Loads, GN&C, Environments, Thermal & Mechanisms, Pyrotechnics
- RS: Budget Analysis, Resource Planning
- QD: Safety & Mission Assurance



MSFC Contributions



- **Current LV Leadership Roles at MSFC**

- Deputy Manager, LVSO
- LV Chief Engineer
- LV Lead Engineer for SpaceX
- LV Chief Safety Officer

- **Current LV System Leads**

- Propulsion (SL at MSFC)
- Specialty Engr (SL at MSFC)
- Avionics/Software (SL at KSC)
- Structures/Mech/Thermal (SL at KSC)
[recent transition]

- **Current LV System Manager and Engineering Expertise**

- Avionics (SM at KSC)
- Software (SM at KSC)
- Mechanical (SM at KSC)
- M&P (SM at KSC)
- Fracture Control (SM at KSC) [recent transition]
- Propulsion (SM at MSFC, Deputy at KSC)

- **Engineering Support**

- Propulsion support to Spacecraft
- Pyrotechnic support to Spacecraft
- ECLSS support to Spacecraft
- GN&C, Environments support to Integrated Performance
- Loads & Dynamics support to Integrated Performance
- Propulsion support to IFAT

- **Collaboration with Launch Service Program (LSP)**

- Hardware acceptance reviews
- Fleet anomaly investigations
- Console training



Jacobs CREW Funded Subtask

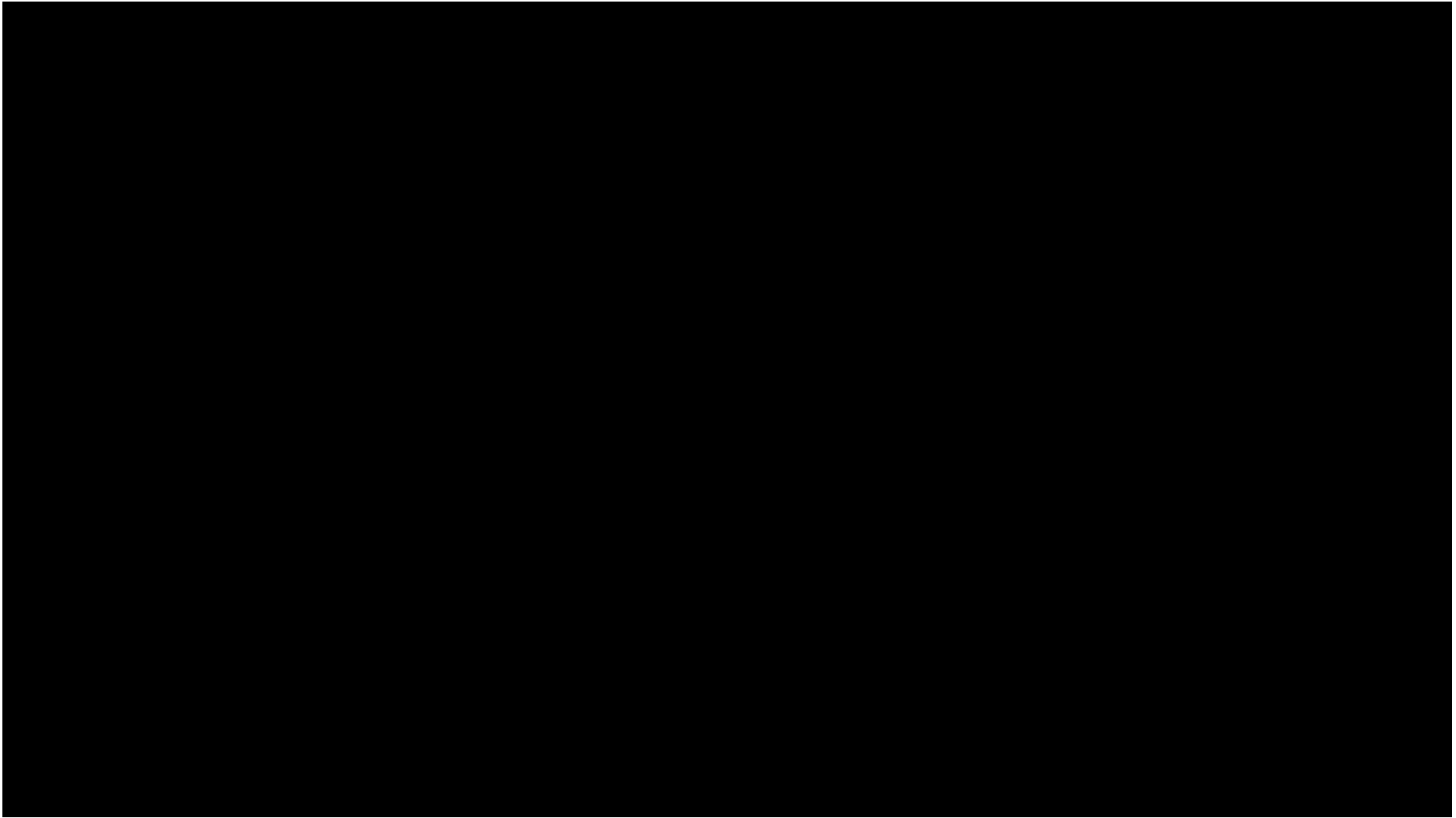


- **Aerodyne Industries**
- **Bevilacqua Research Corp**
- **CFDRC**
- **CRM Solutions**
- **Draper Labs**
- **Dynamic Concepts, Inc.**
- **Dynetics Technical Services, Inc.**
- **ERC, Inc.**
- **GeoControl Systems, Inc.**
- **Linc Research, Inc.**
- **Qualis**
- **QuantiTech, Inc.**
- **TriVector Services, Inc.**
- **Tuskegee University**



What it was all for

(Let's Go Fly!!!)





Summary



Summary

The Commercial Crew Program has challenged the way NASA does business. NASA has had to re-evaluate their technical insight model and rely more on a Shared Accountability and Assurance model with the commercial launch vehicle provider. This means less component level testing and a re-evaluation of what factor of safety is truly needed. The partnership approach allows NASA engineers insight into a company's development process while the agency's technical expertise and resources are accessible to a company.

- **Boeing and SpaceX are meeting contractual milestones and maturing their spaceflight systems**
 - Risks are being identified and important design challenges are being addressed
 - NASA is engaged in meaningful insight
- **Both providers are making tangible progress toward test flights and post certification missions to the International Space Station**



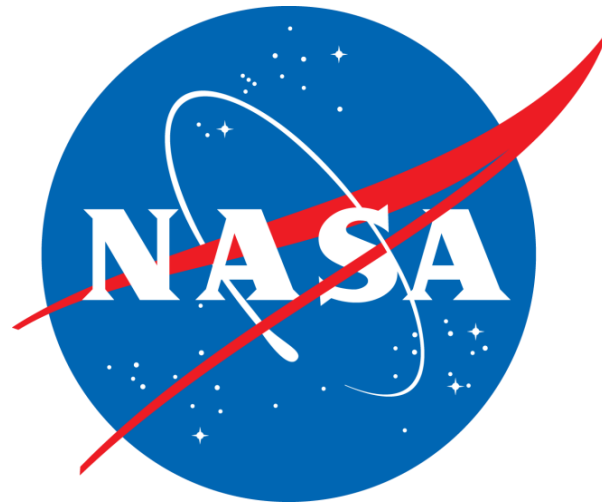
*Boeing CST-100
Starliner*



*SpaceX Crew
Dragon*

Forward Work

- MSFC remains substantially committed to the success of CCP
- Transition plans for Post Certification Missions
- SpaceX Booster Re-use certification
- Boeing/ULA Vulcan and GEM63 upgrades



Questions?

Rajiv Doreswamy, Ph.D.
rajiv.doreswamy@nasa.gov