



# Boeing CST-100

Commercial Crew Transportation System

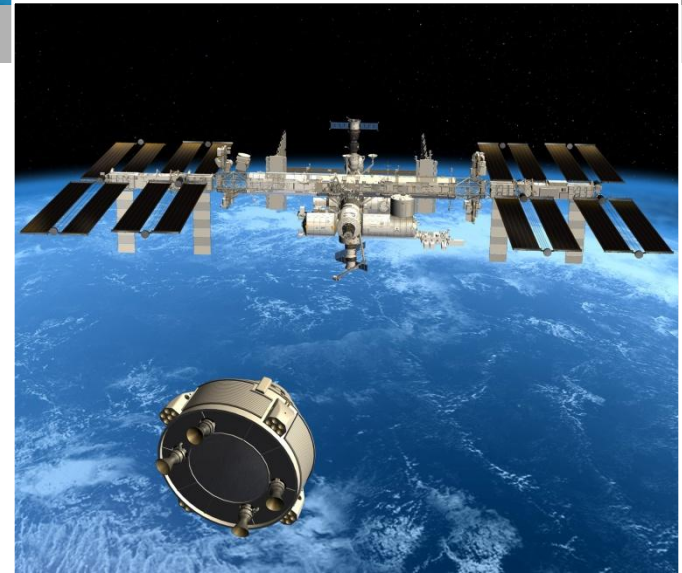
Keith Reiley, The Boeing Company

February, 2011

# Commercial Crew Transportation System (CCTS)

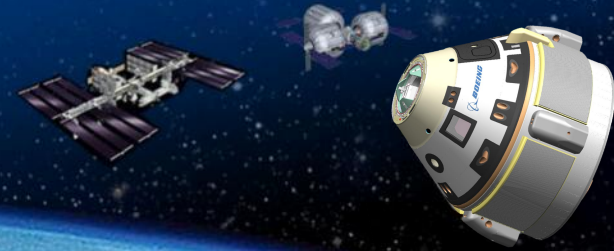
Space Exploration | NASA Commercial Crew Development (CCDev)

- **Design objectives dictate simple systems and proven components**
  - Safe and reliable
  - Low recurring cost
  - Low development risk
- **Compatible with a variety of launch vehicles**
- **Operational in 2015**
- **Complete transportation system**
  - Spacecraft
  - Launch Vehicle
  - Ground Operations
  - Mission Operations
  - Recovery





# CCTS Overview



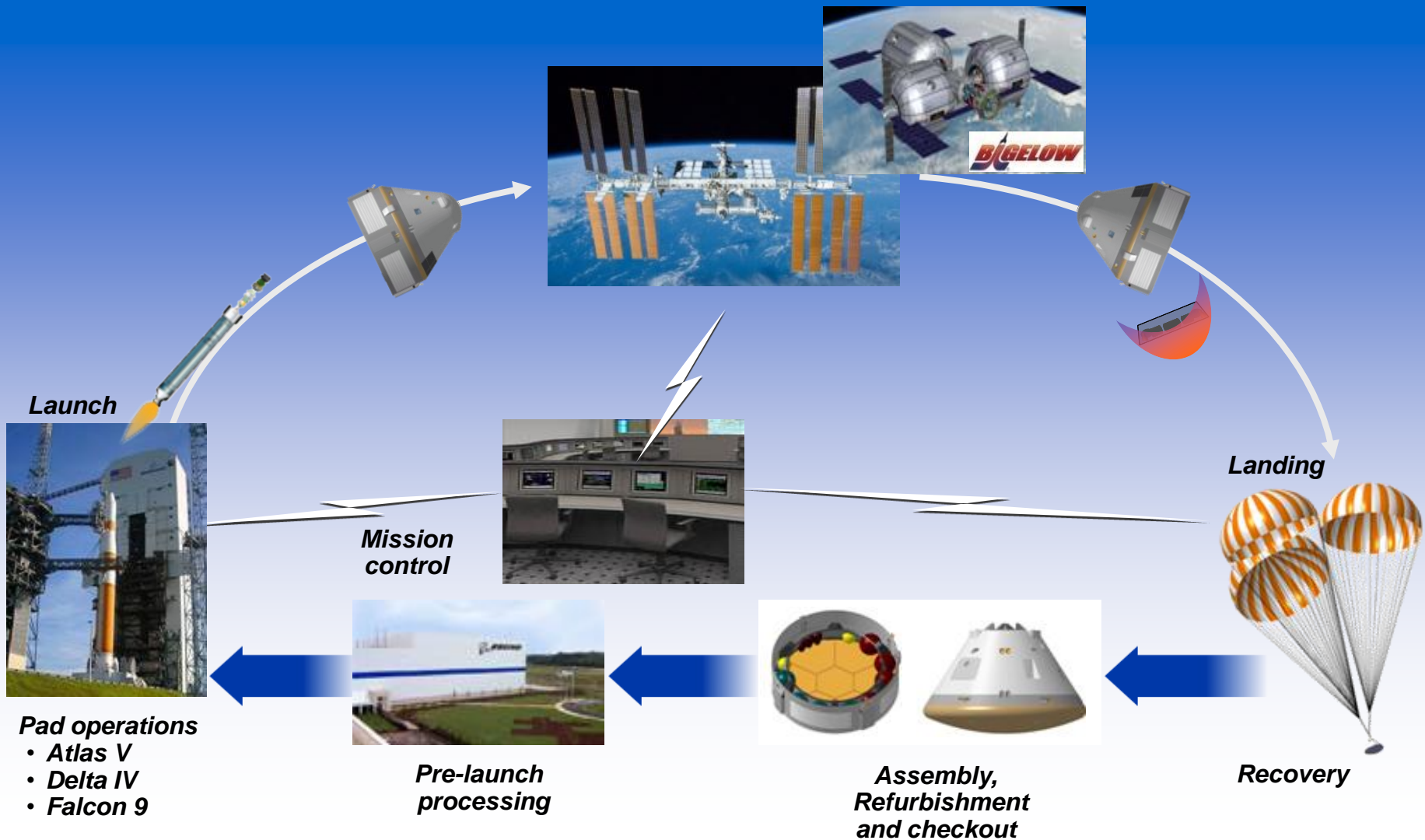
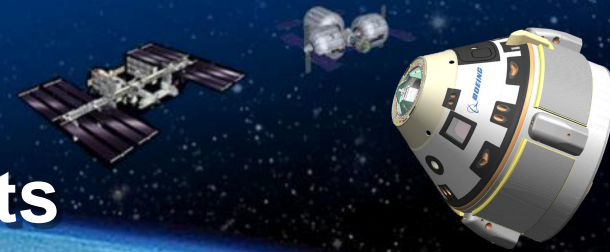
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- **Commercial Crew Transportation System (CCTS)**

- Flexible vehicle with crew/cargo mix with up to seven crew
- Compatible with Atlas, Delta, and Falcon 9 and potentially other launch vehicles
- Use of proven high-TRL subsystems
- Leverages extensive experience and hardware from Apollo, Shuttle, ISS, Orbital Express, etc.
- 48 hours autonomous on-orbit capability
  - First day docking within 8 hours
  - 6 hours undock to landing
  - 24 hour contingency for day 2 docking or ISS safe-haven
- 210 days docked duration capability
  - Host vehicle provides < 1 kW “keep alive” power
- Nominal land landing with contingency water landing capability
- Abort propellant available for host vehicle reboost

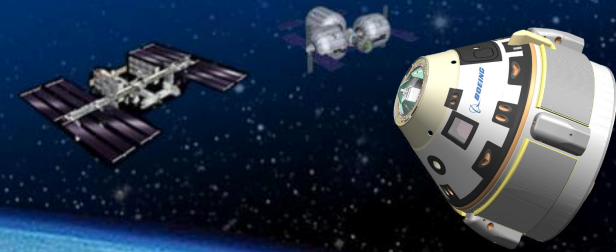


# Operations Concept Supports Crew Transportation Requirements



# Boeing CCDev Approach

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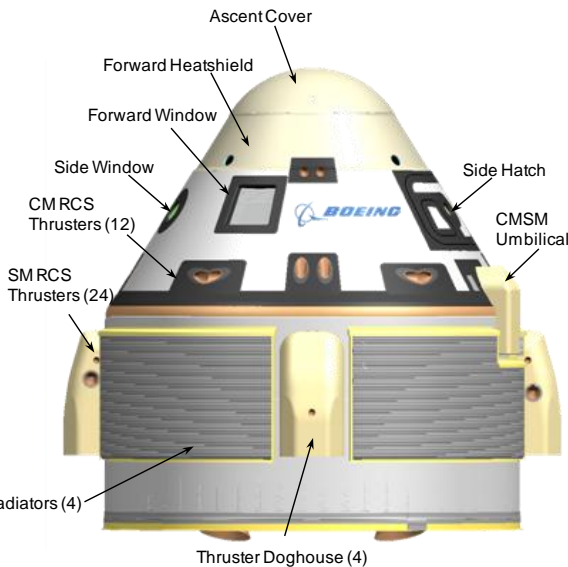


## • Commercial Crew Transportation System concept:

- ◆ Flexible crewed vehicle concept with maximum of seven crew
- ◆ Pusher Launch Abort System for range of launch vehicles which provides additional propellant to reboost customer platforms
- ◆ Light-weight design compatible with Atlas, Delta, and Falcon 9
- ◆ Integrated operations & crew training center

## • Mature system architecture and design through SDR and demonstrates key technologies and capabilities via 9 primary tasks

- ◆ SDR
- ◆ Abort System Engine Demonstration
- ◆ Base Heat Shield Fabrication Demonstration
- ◆ Avionics Systems Integration Facility Demonstration
- ◆ CM Pressurized Structure Fabrication Demonstration
- ◆ Landing System Demonstration
- ◆ Life Support Demonstration
- ◆ Automated Rendezvous & Docking (ARD) Integrated GNC Demonstration
- ◆ Crew Module Mockup Demonstration

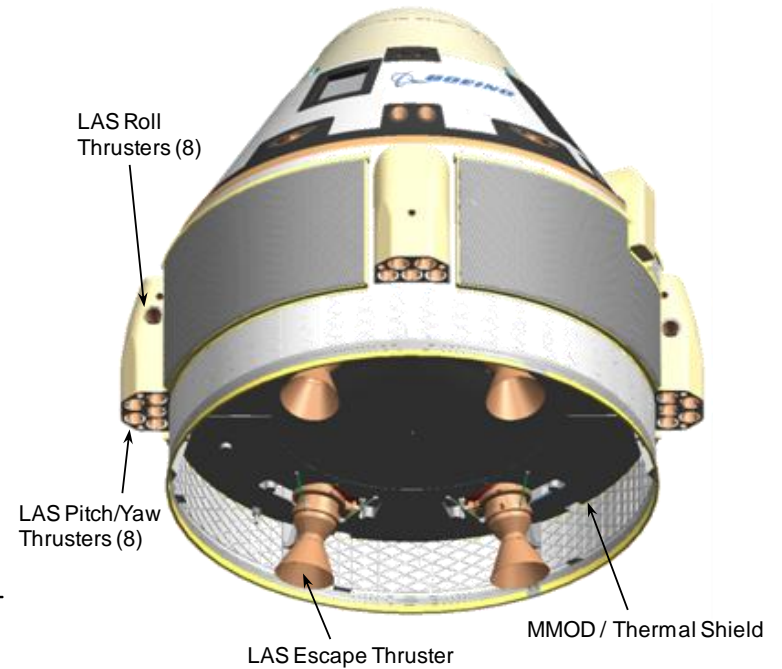
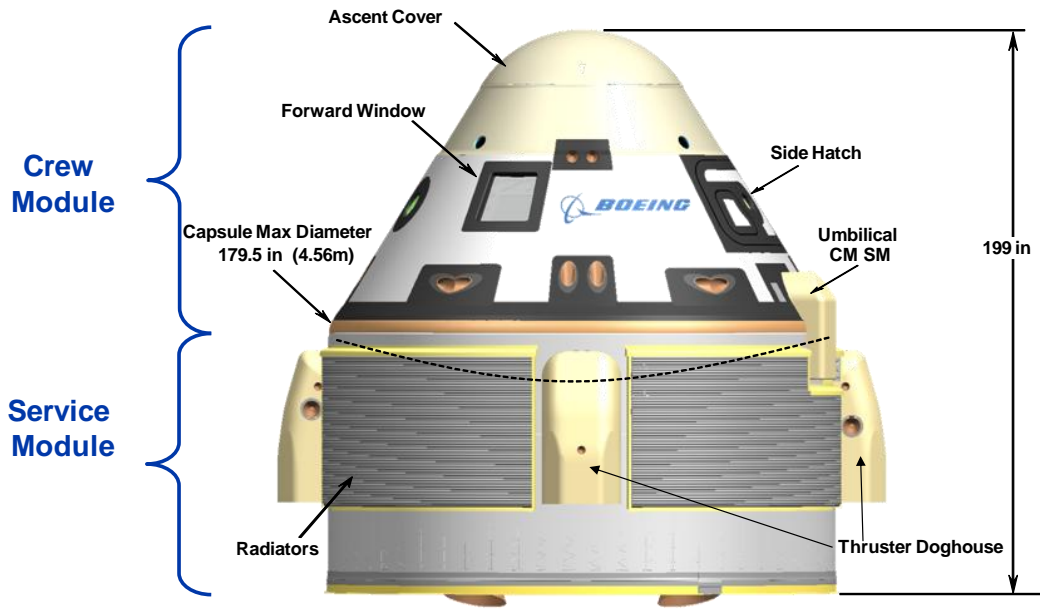
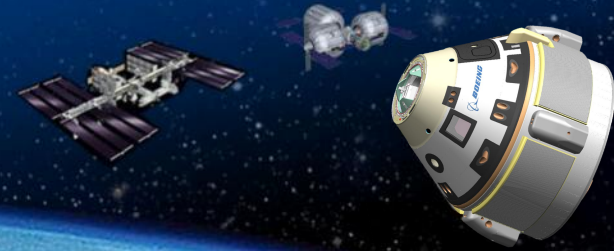


## Partners & Subs

Bigelow Aerospace  
Pratt Whitney Rocketdyne  
Airborne Systems  
ILC Dover  
Spincraft

# CST-100 Configuration

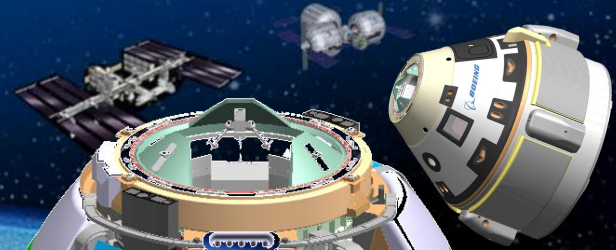
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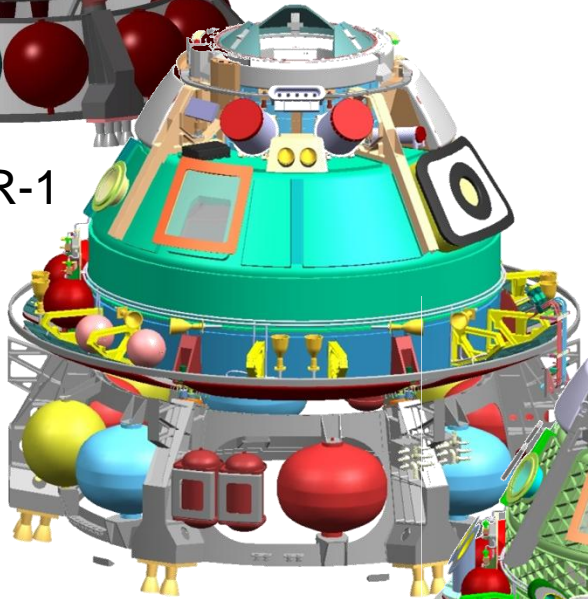


# CCV Evolution

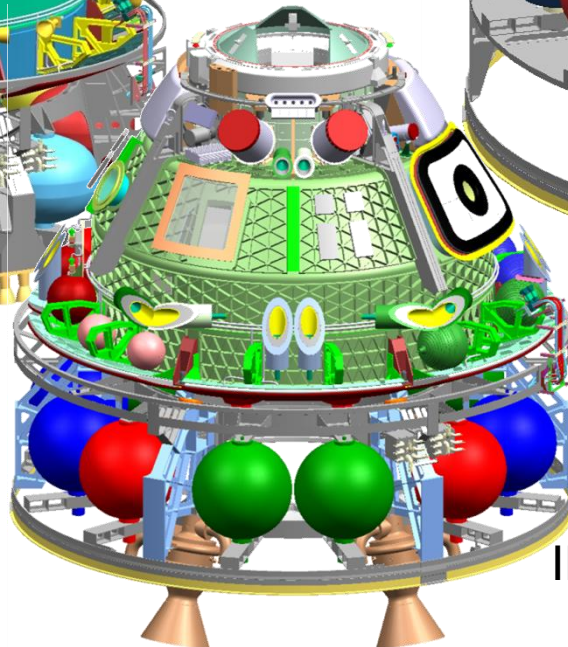
NASA Commercial Crew Development (CCDev)



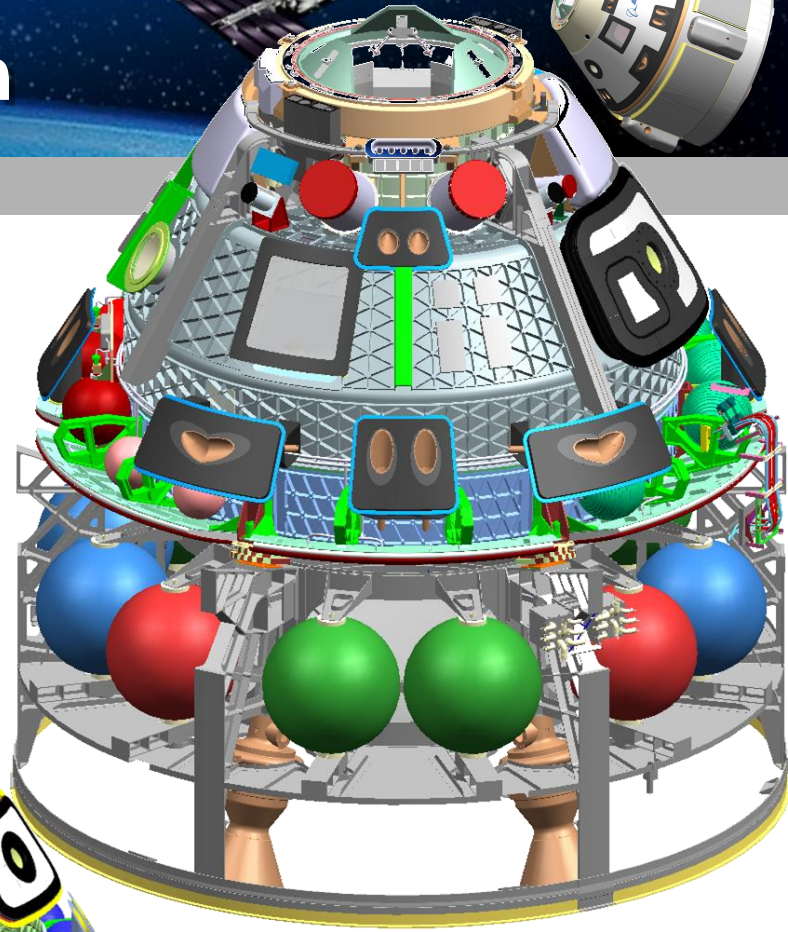
IDR-1



IDR-2



IDR-3

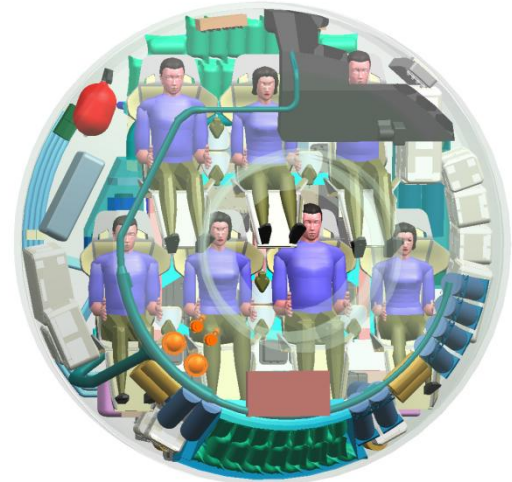
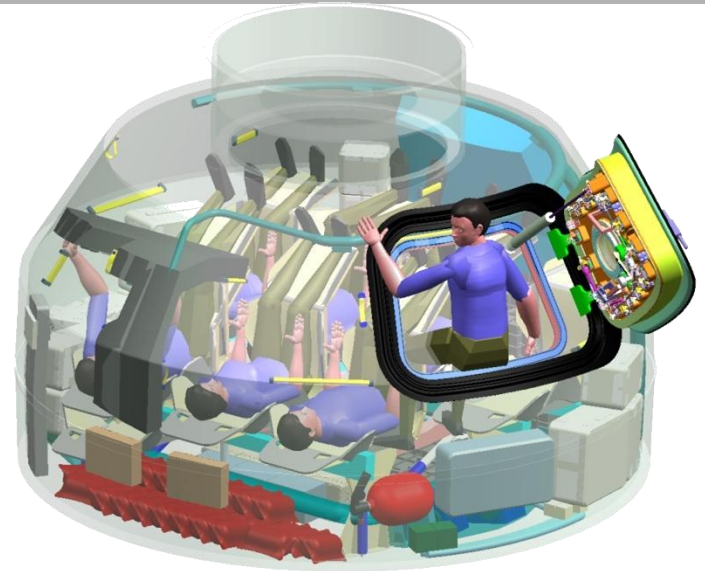
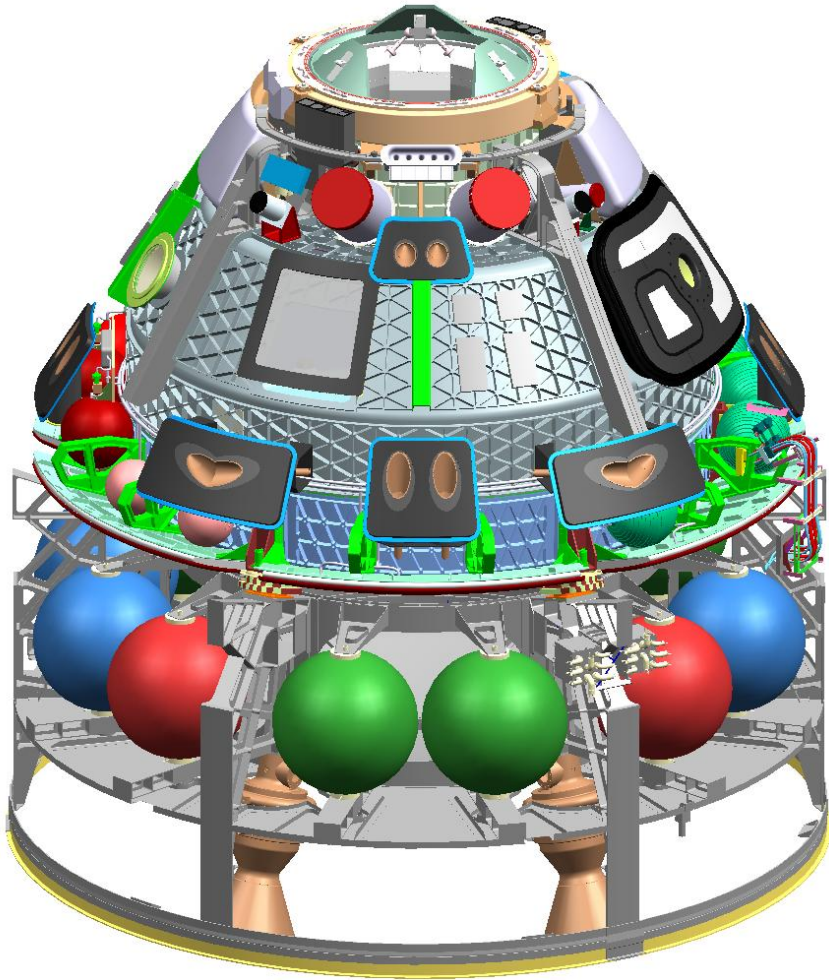
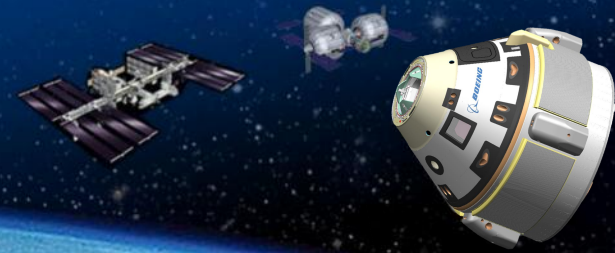


SDR



# CST-100 Layout

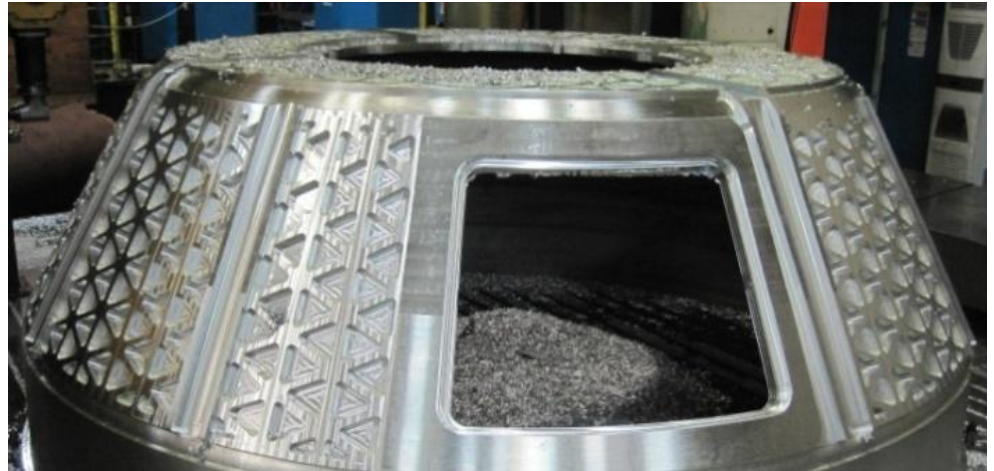
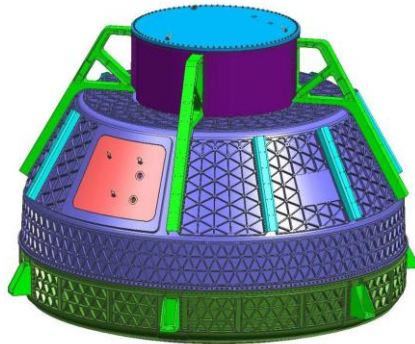
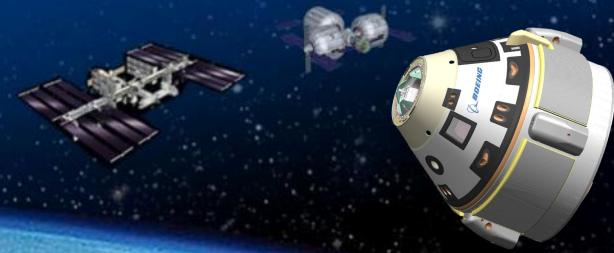
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# CST-100 CM Pressurized Structure Fabrication & Test

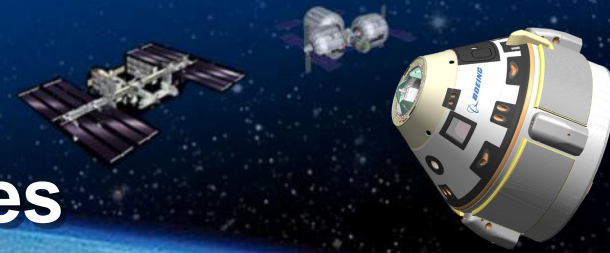
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**CM Pressurized Structure  
From Concept to Finished Product**

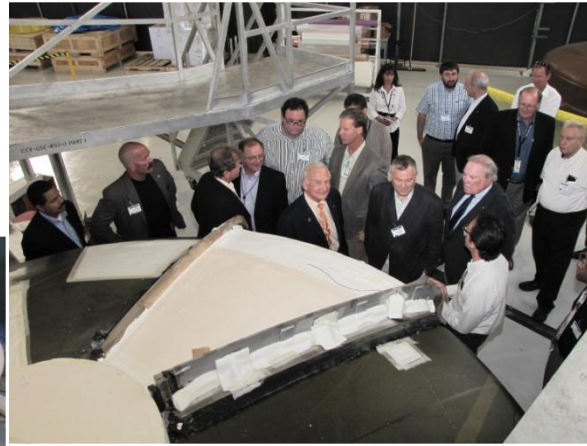


# CST-100 CCDev Design Maturation – Adapted Technologies



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**Heat Shield Carrier  
Structure Fabrication**



**BHS Ablator  
Installation**

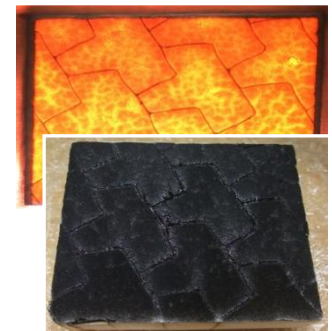
**BHS Ablator  
Machining**



**Abort Engine  
Hot Fire**

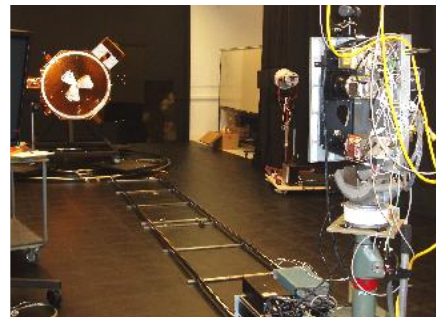


**Avionics and Software  
Integration Lab**



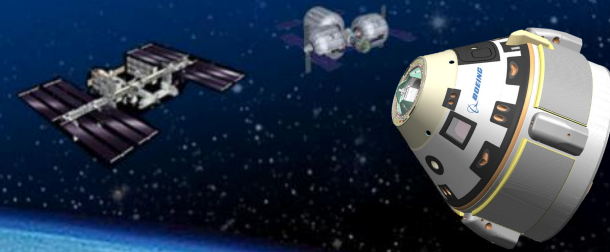
**Arc Jet Test**

**Integrated AR&D Sim**

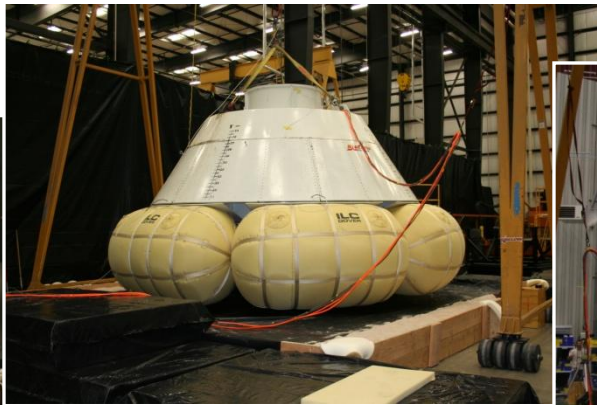




# CST-100 CCDev Design Maturation – Landing Drop Tests



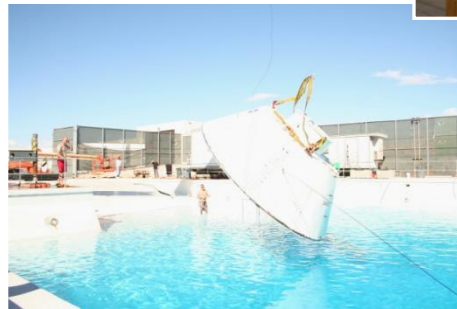
Space Exploration | NASA Commercial Crew Development (CCDev)



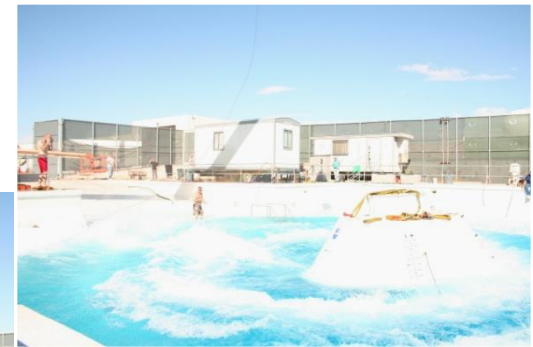
**CM Air Bag Drop Test**



**Water Landing  
Up-Righting Test**

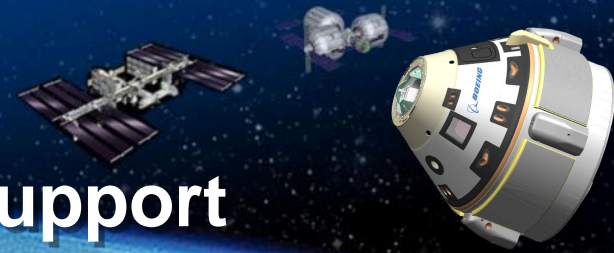


**CM Water  
Drop test**

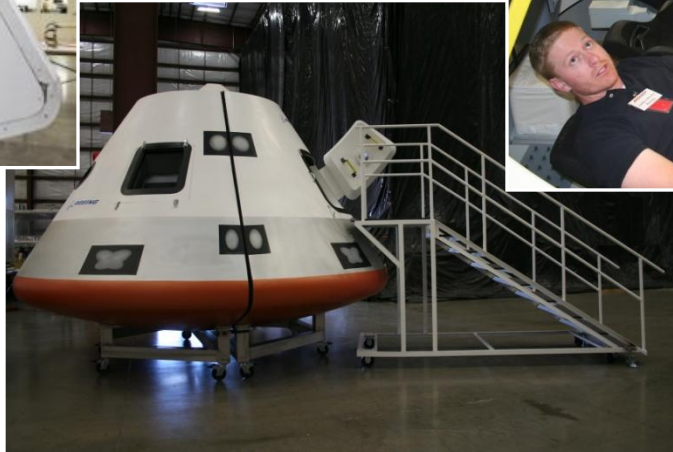


# CST-100 CCDev Design Maturation – CM Mock-up & Life Support

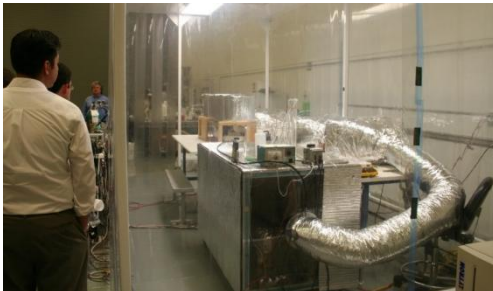
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*Crew Module Mockup*

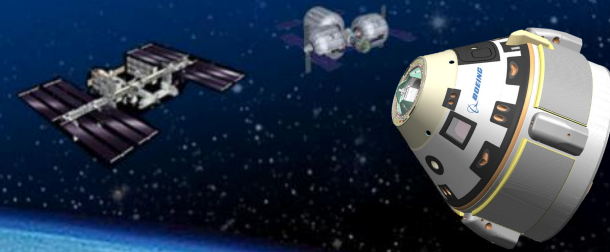


*Life Support Demonstration*





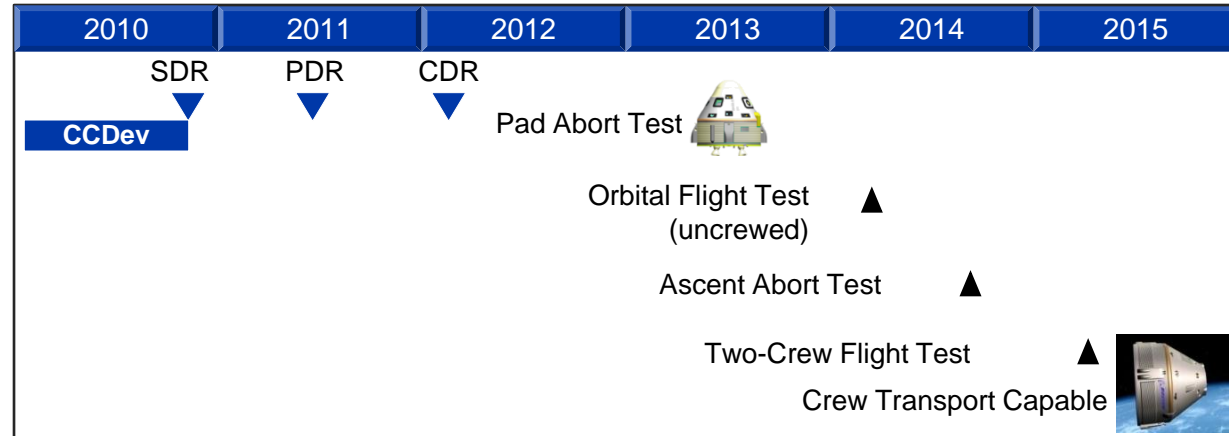
# Full Crew Transportation Capability by 2015



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## ■ CST-100 takes advantage of heritage hardware to reduce schedule risk

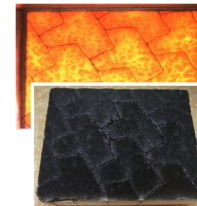
- APAS docking system
- Orbital Express demonstrated AR&D
- Apollo heritage parachute system
- Abort system using existing components
- BLA from other programs
- Delta based spin formed structures
- Airbag landing system from CEV/Orion



*Air Bag System*



*APAS Hardware*



*Boeing Lightweight Ablator*



*Weldless structure*



*Integrated AR&D System*



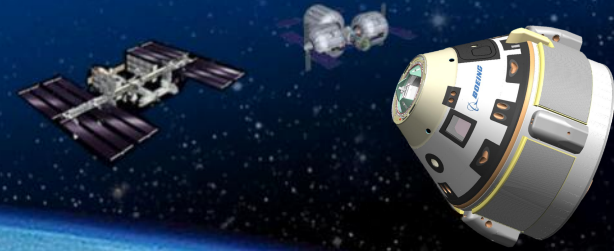
*SM Abort Engine*



*Simple, passive life support systems*

# CCTS Technology utilization Summary

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- **Boeing's commercial crew initiative is not about inventing new technologies**
- **It is the integration of existing technologies into a safe, reliable transportation system**
- **System design is driven by safety, reliability and cost, not performance**
- **Simplicity is king**

