Launching the Future of Science and Exploration
Engineering Directorate Overview
A Briefing to the Marshall Small Business Association

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Abstract

The Marshall Small Business Association (MSBA) serves as a central point of contact to inform and educate small businesses interested in pursuing contracting and subcontracting opportunities at the Marshall Space Flight Center. The MSBA meets quarterly to provide industry with information about how to do business with Marshall and to share specific information about Marshall’s mission, which allows private businesses to envision how they might contribute. For the February 19 meeting, the Engineering Directorate will give an overview of its unique capabilities and how it is organized to provide maximum support for the programs and projects resident at Marshall, for example, the Space Shuttle Propulsion Office, Ares Projects Office, and Science and Mission Systems Office. This briefing provides a top-level summary of the work conducted by Marshall’s largest organization, while explaining how resources are deployed to perform the volume of work under Marshall’s purview.
NASA’s Strategic Goals

- Retire the SHUTTLE by 2010
- Complete the INTERNATIONAL SPACE STATION
- Return to THE MOON by 2020
- Carry out MISSIONS of SCIENTIFIC DISCOVERY
- Advance U.S. aeronautics TECHNOLOGY LEADERSHIP
- Pursue PARTNERSHIPS with commercial space sector
- Provide critical capabilities to SUPPORT NASA’s MISSION

Working with Prime and Support Contractors to Achieve NASA’s Goals
Marshall has a key role in NASA’s mission.
Empowering Space Exploration

Lifting from Earth: Propulsion and Transportation Systems

Living and Working in Space: Human Exploration Systems and Operations

Understanding Our World and Beyond: Scientific Spacecraft, Instruments, and Research

Contributing Unique Aerospace Expertise and Facilities
Exploring in Earth Orbit and Beyond

Safely flying the Shuttle to complete the International Space Station and service the Hubble Space Telescope

Developing innovative propulsion technologies

Engineering avionics, structures, materials, and mechanisms

Developing the Ares I crew launch and the Ares V cargo launch vehicle

Designing the Upper Stage and Integrating the Ares I Stack In House

First test flight is scheduled for 2009

Opening the Door to Discovery
Building on Proven Systems and Experience Base

Saturn V
- S-IC (Five F-1 engines)
- S-II (Five J-2 engines)
- S-IVB (One J-2 engine)
- Command/Service Module
- Lunar Lander
- One 5-Segment Reusable Solid Rocket Booster (RSRB)

Orion Crew Exploration Vehicle
- Upper Stage (One J-2X engine)
- Earth Departure Stage (EDS) (One J-2X engine)

Core Stage
- (Six RS-68 Engines)

Overall Vehicle Height, m (ft)
- 122 m (400 ft)
- 91 m (300 ft)
- 61 m (200 ft)
- 30 m (100 ft)
- 0

Saturn V
- Height: 110.9 m (364 ft)
- Payload Capability: 44.9 metric tons (99,000 lbs) to TLI, 118.8 metric tons (262,000 lbs) to LEO

Space Shuttle
- Height: 56.1 m (184.2 ft)
- Payload Capability: 25.0 mT (55,000 lbs) to LEO

Ares I
- Height: 99.1 m (325 ft)
- Payload Capability: 25.5 mT (56,200 lbs) to LEO

Ares V
- Height: 116.2 m (381.1 ft)
- Payload Capability: 187.7 mT (413,800 lbs) to LEO, 71.1 mT (156,700 lbs) to TLI with Ares I, 62.8 mT (138,500 lbs) direct to TLI

mT – metric tons
TLI – Trans-Lunar Injection
LEO – Low Earth Orbit
Making Possible Off-Planet Operations

Life Support and Science
- Producing Clean Air and Recycling Water
- Managing Science Operations Around-the-Clock
- Making Science Experimentation Possible in Space

Future Systems
- Providing Exploration Life Support Systems and Radiation Hardened Electronics
- Developing Altair Lunar Lander Systems
- Utilizing Lunar Resources

Helping Crews Survive and Thrive in Space
Supporting the Range of Science Missions

Earth Science:
- Monitoring the Environment
- Accurately Predicting Weather
- Researching Hurricane Activities

Space Science:
- Preparing for crewed missions to the Moon with robotic precursor spacecraft
- Learning about Earth’s planetary neighborhood
- Discovering secrets of the cosmos

Delivering Systems that Expand Knowledge and Improve Life on Earth
Crosscutting Capabilities for Marshall’s Product Lines
Engineering Directorate Capabilities

Advanced Concepts
- Concept Definition, Integration, & Analysis
  - Earth-to-Orbit Transportation
  - In-Space Transportation
  - Planetary Surface Systems
- Mission Analysis
- Architecture Analysis
- Technology Assessments

Space Systems
- Systems Engineering & Integration
- Avionics
- Software
- Electrical Integration
- Mechanical Systems
- Fabrication & Assembly Services
- Environmental Control & Life Support Systems

Spacecraft & Vehicle Systems
- Systems Engineering & Integration
- Tank/Structures Design
- Loads & Dynamics
- Mechanisms
- Terrestrial & Space Environments
- Induced Environments
- Modeling & Simulation
- Guidance, Navigation, & Control

Propulsion Systems
- Propulsion Engineering
- Liquids & Solids
- Component Design
- Fluid Systems Design & Analysis
- Computational Fluid Mechanics
- In-Space Propulsion
- Nuclear Propulsion

Organized for Mission Success
Engineering Directorate Capabilities (continued)

Mission Operations
- Operations Concepts
- Ground Systems
  - Design Development
  - Certification
  - Operation
- Flight Operations
  - Mission Design
  - Crew Procedures & Timelines
  - Flight Controller Cert.
  - On-board Facility Ops

Materials & Processes
- Metallics
- Composites
- Ceramics
- Environmental Effects
- Fracture & Failure Analysis
- NDE & Tribology
- Chemistry & Combustion Research

Test Lab
- Propulsion Testing
- Structural Testing
- Thermal Vacuum
- Shock & Vibration
- Acoustic
- Experimental Fluids Test & Development
- Advanced Instrumentation Application

Organized for Mission Success
Organized for Mission Success
For More Information

Marshall Space Flight Center
www.nasa.gov/centers/marshall

Doing Business With Marshall
http://ec.msfc.nasa.gov/msfc/doin_bus.html
Ares I Elements

Upper Stage
- 137.1 mT (302.2K lbm) LOX/LH2 prop
- 5.5-m (18-ft) diameter
- Aluminum-Lithium (Al-Li) structures
- Instrument unit and interstage
- Reaction Control System (RCS) / roll control for first stage flight
- Primary Ares I control avionics system
- NASA Design / Boeing Production ($1.12B)

Upper Stage Engine
- Saturn J–2 derived engine (J–2X)
- Expendable
- Pratt and Whitney Rocketdyne ($1.2B)

Instrument Unit
- Primary Ares I control avionics system
- NASA Design / Boeing Production ($0.8B)

Orion CEV

Interstage

Stack Integration
- 927.1 mT (2,044.0K lbm) gross lift off mass
- 99.1 m (325.0 ft) in length
- NASA-led

First Stage
- Derived from current Shuttle RSRM/B
- Five segments/Polybutadiene Acrylonitrile (PBAN) propellant
- Recoverable
- New forward adapter
- Avionics upgrades
- ATK Launch Systems ($1.8B)