
NASA
NASA'S
MSFC Welding
Development
for *Ares* I
*Jeff Ding*
*Aerospace Welding Engineer*
*Marshall Space Flight Center*
www.nasa.gov
ARES

# NASA's MSFC Welding Development for *Ares* I Program

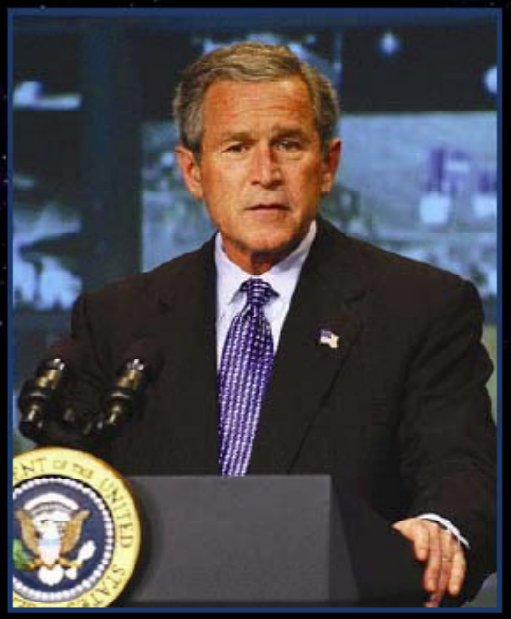
## AGENDA

- Introduction
- Video of NASA's Constellation Program
- Vehicle Configuration
- MSFC Welding/Fabrication Capabilities
- Weld Tools for *Ares* I Fabrication/Welding
- Closing Remarks / Questions

Jeff Ding
October 2, 2008
robert.j.ding@nasa.gov

# A Bold Vision for Space Exploration

- Complete the International Space Station
- Safely fly the Space Shuttle until 2010
- Develop and fly the Crew Exploration Vehicle no later than 2014
- Return to the Moon no later than 2020



**NASA Authorization Act of 2005**

"The Administrator shall establish a program to develop a sustained human presence on the Moon, including a robust precursor program to promote exploration, science, commerce and U.S. preeminence in space, and as a stepping stone to future exploration of Mars and other destinations."

# NASA's MSFC Welding Development for *Ares* I Program

**INSERT MOVIE**

**Jeff Ding**
**October 2, 2008**
**robert.j.ding@nasa.gov**

# NASA's MSFC Welding Development for *Ares* I Program

Launch Abort System

Crew Exploration Vehicle (CEV)
(Crew Module / Service Module)

Spacecraft Adapter

Instrument Unit

Forward Skirt

Upper Stage

J-2X Upper Stage Engine

Interstage

Forward Frustum

First Stage
(5-Segment RSRB)

***Ares* I**

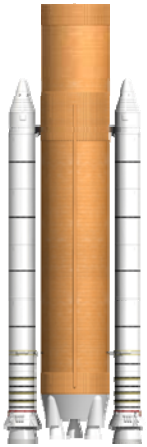
48k lbm to LEO

Composite Shroud

Lunar Surface Access Module (LSAM)

**Earth Departure Stage**
$LOx/LH_2$
1 J-2X Engine
Al-Li Tanks/Structures

Interstage



**Core Stage**
$LOx/LH_2$
5 RS-68 Engines
Al-Li Tanks/Structures

2
5-Segment
RSRB's

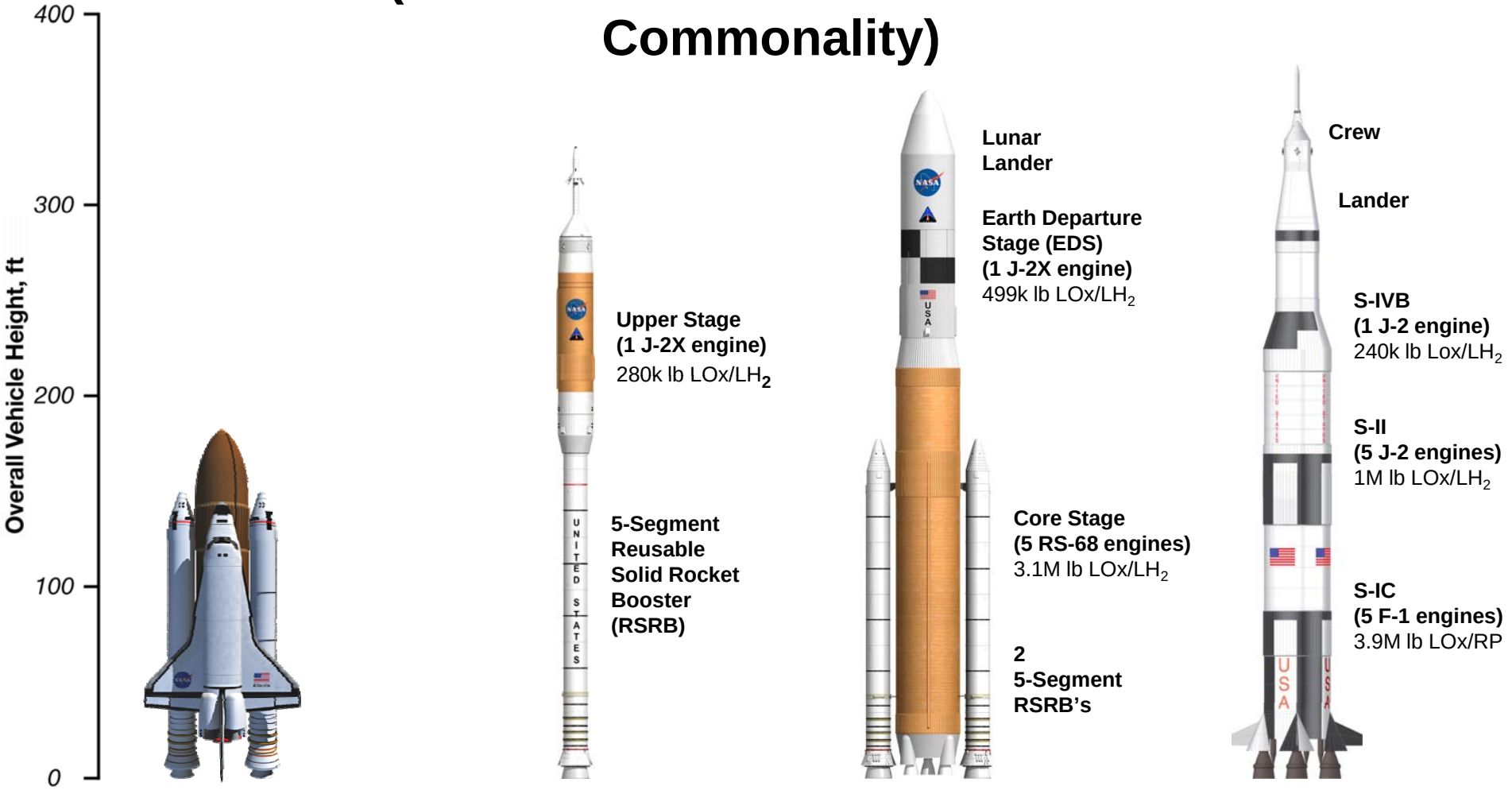
117k lbm to TLI
144k lbm to TLI in Dual-Launch Mode with *Ares* I
290k lbm to LEO

***Ares* V**

Jeff Ding
October 2, 2008

robert.j.ding@nasa.gov

# Launch Vehicles Comparisons (Blue Arrows Indicate Hardware Commonality)




## Space Shuttle

**Height:** 184.2 ft
**Gross Liftoff Mass:** 4.5M lb

55k lbm to LEO

## *Ares* I

**Height:** 321 ft
**Gross Liftoff Mass:** 2.0M lb

48k lbm to LEO

## *Ares* V

**Height:** 358 ft
**Gross Liftoff Mass:** 7.3M lb

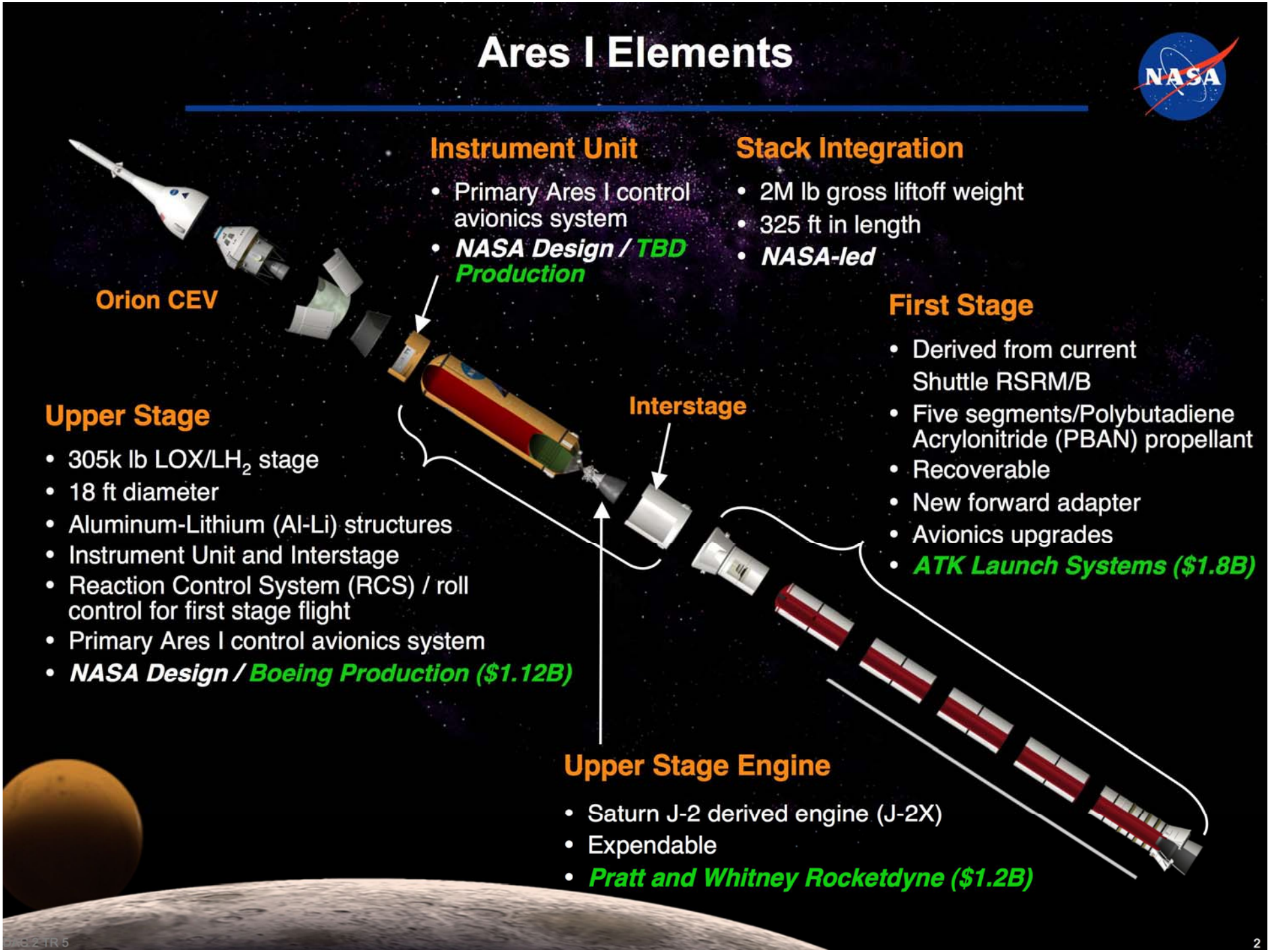
117k lbm to TLI
144k lbm to TLI in Dual-Launch Mode with *Ares* I
290k lbm to LEO

## Saturn V

**Height:** 364 ft
**Gross Liftoff Mass:** 6.5M lb

99k lbm to TLI
262k lbm to LEO

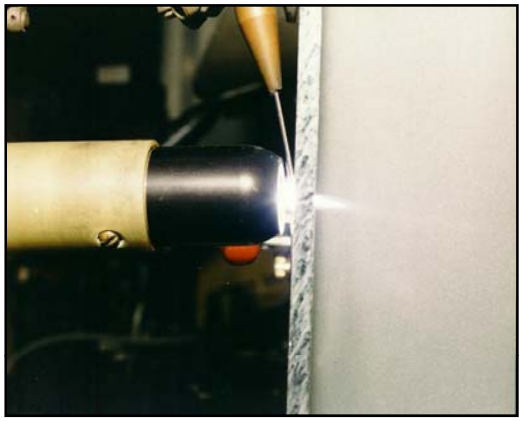
# Ares I Elements



# In-House Capabilities

- **Fusion Welding**
  - GTAW
  - PAW & VPPAW
  - GMAW, SMAW, etc…
- **Friction Stir Welding**
  - Conventional and Self Reacting
  - High Speed
- **Friction Plug Welding**
  - Push and Pull Plug Welding
- **Thermal Stir Welding**
- **Electron Beam Welding**
- **Thermal Spray Processing**
  - Vacuum Plasma Spray
  - Arc Spray
  - High Velocity Oxy Fuel Spray
- **Space Environment Simulation**
  - Space Welding
  - RCC and Tile repair
- **Machine Shop**
  - CNC Mills and Laths
  - Fabrication of Pin Tools, Fixtures, Test Rigs, etc.
  - Mechanical and Metallurgical test specimen prep

***High Speed FSW***



***Plasma Welding***

***In-Space Simulation***

***Vacuum Plasma Spray***

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# WELD TOOLS SUPPORTING *ARES* I FABRICATION

Jeff Ding
October 2, 2008
robert.j.ding@nasa.gov

# NASA's MSFC Welding Development for *Ares* I Program

## GROUNDRULES FOR *ARES* I MANUFACTURING

- All technology must be TRL 6
- Self Reacting Friction Stir Welding is preferred process for making circumferential welds
- Plug Repair for Keyhole Closeout
- Conventional FSW is preferred process for making straight linear welds
- Common Bulkhead

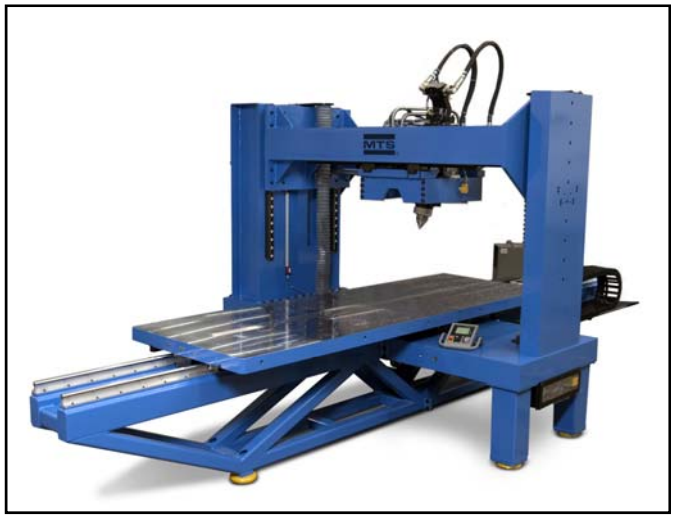
Jeff Ding
October 2, 2008
robert.j.ding@nasa.gov

# NASA's MSFC Welding Development for *Ares* I Program

MSFC Vertical Weld Tool used for ET Development
14 foot welds

**Thermal Stir Welding (STW) System**

- TSW, C-FSW, SR-FSW


**Production Development System (PDS)**

- 5 degrees of freedom
- Small but extremely capable machine that is ideal for development work.

Jeff Ding
October 2, 2008

robert.j.ding@nasa.gov

# NASA's MSFC Welding Development for *Ares* I Program

Universal Welding System (MAF)

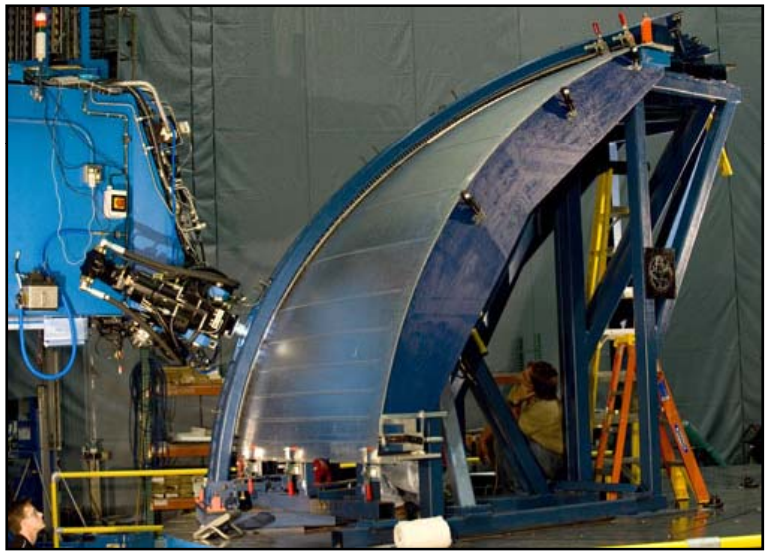
External Tank Production
Conventional FSW only

Jeff Ding
October 2, 2008

robert.j.ding@nasa.gov

# NASA's MSFC Welding Development for *Ares* I Program

## Robotic Weld Tool (RWT)

- 7 degrees of freedom
- Capable of circumferential and complex curvature welds in structures up to 36 feet in diameter.
- Max welding height is 22.5 feet. However, structures up to ~ 60 feet-tall can be supported on the table.

Jeff Ding
October 2, 2008
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# NASA's MSFC Welding Development for *Ares* I Program


New MSFC Vertical Weld Tool capable of 25 foot long welds in barrels exceeding 40 feet in diameter

Vertical Weld

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October 2, 2008
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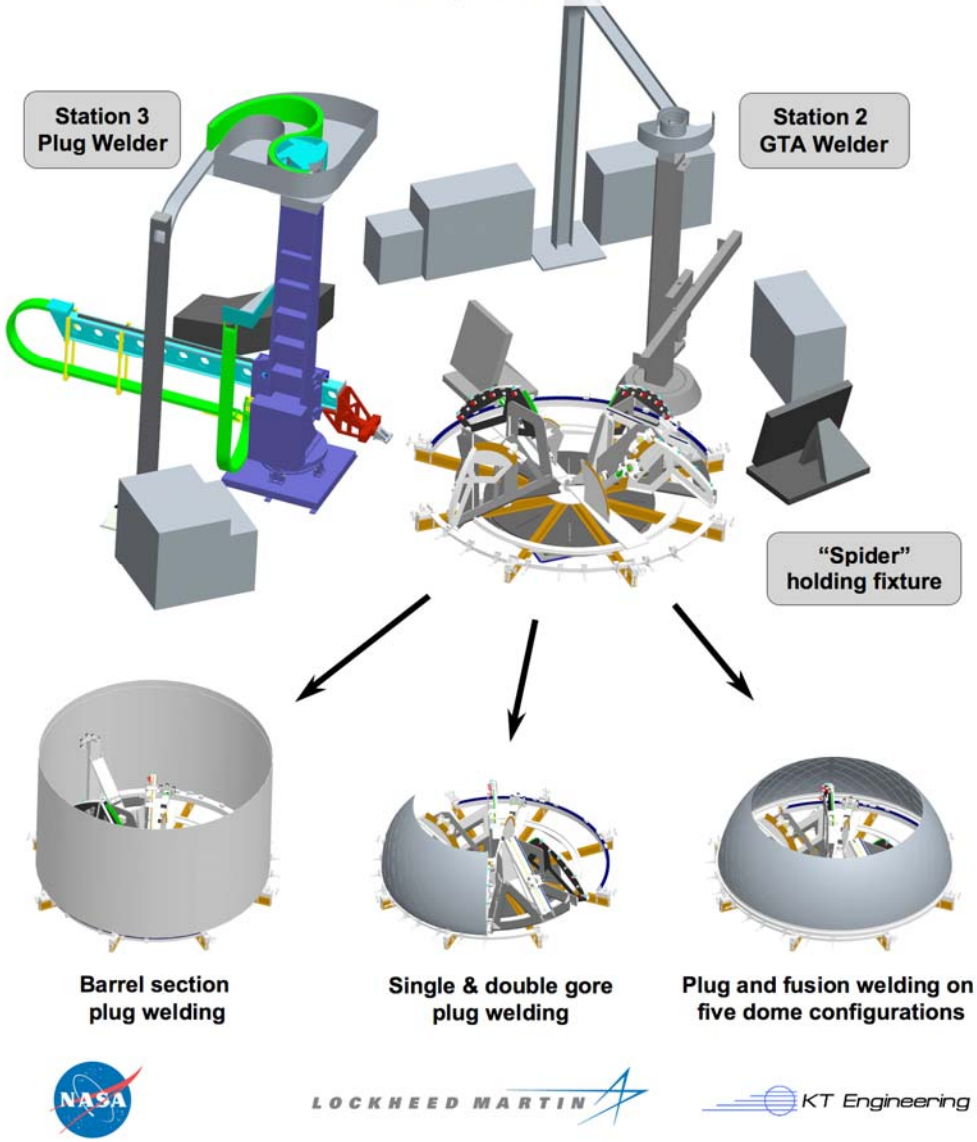
# Dome/Gore Processing Station

*Multi-purpose station for performing friction stir plug welds and GTA seam welds on Ares I upper stage gores, domes, and barrels*

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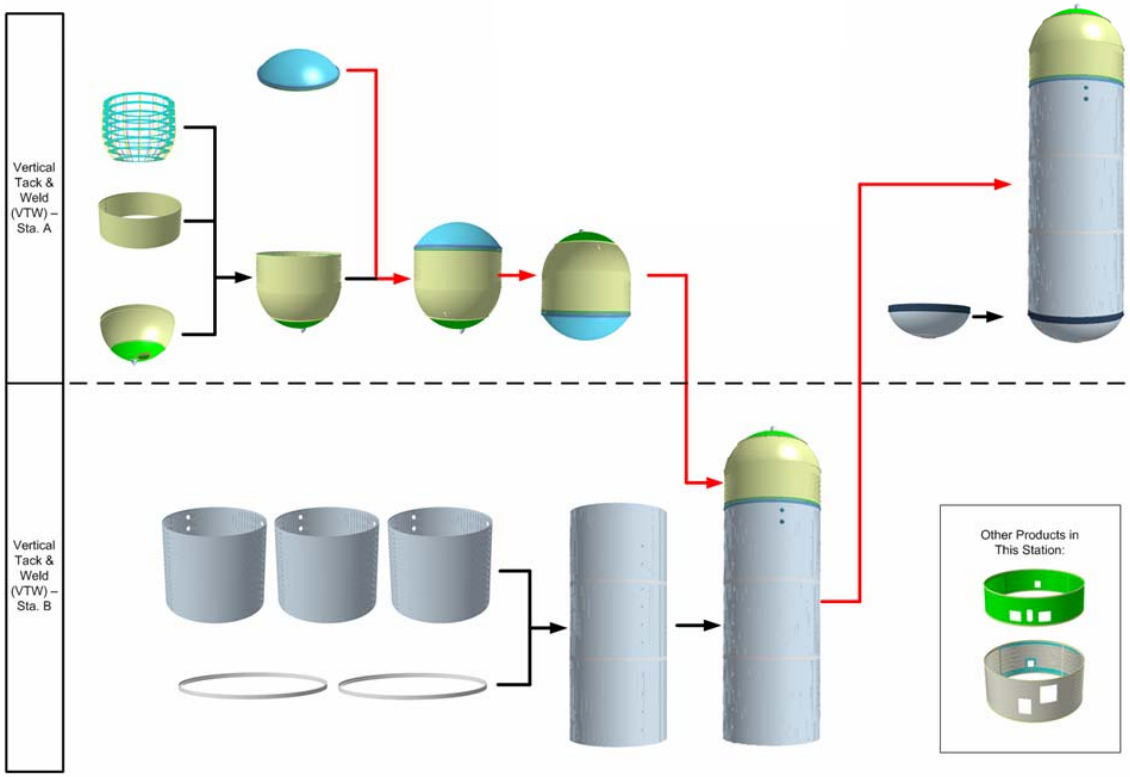
## STACKING PROCESS FOR VERTICAL ASSEMBLY



# NASA's MSFC Welding Development for *Ares* I Program

## CLOSING REMARKS / QUESTIONS

- **Prime contractors – selected for ARES I Prod.**
- **ARES I on schedule for flights beginning 2014**
  - **March: Orion 1 – unmanned**
  - **September: Orion 2 – manned**
  - **June 2015: Orion 3 - manned**

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**2014:**

**March: Orion 1**
launcher: Ares I-3
launch site:
mission: unmanned test flight

**September: Orion 2**
launcher: Ares I-4
launch site:
mission: manned flight

**2015:**

**June: Orion 3**
launcher: Ares I-5
launch site:
mission: manned flight