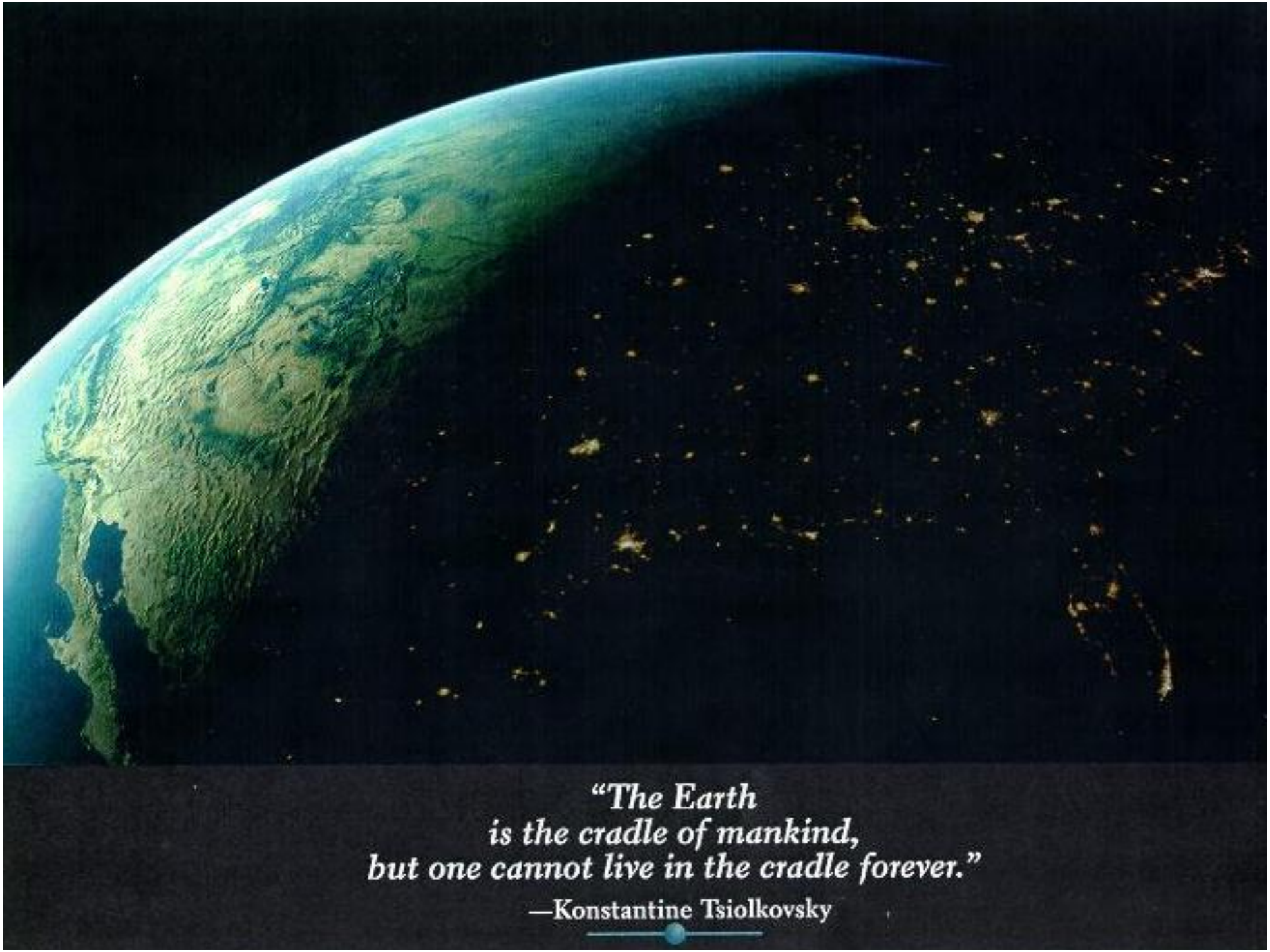
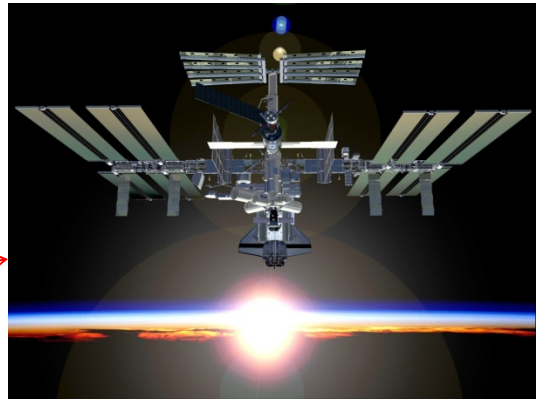
Space Shuttle Processing, International Space Station, and Where We Go From Here

June 8, 2012

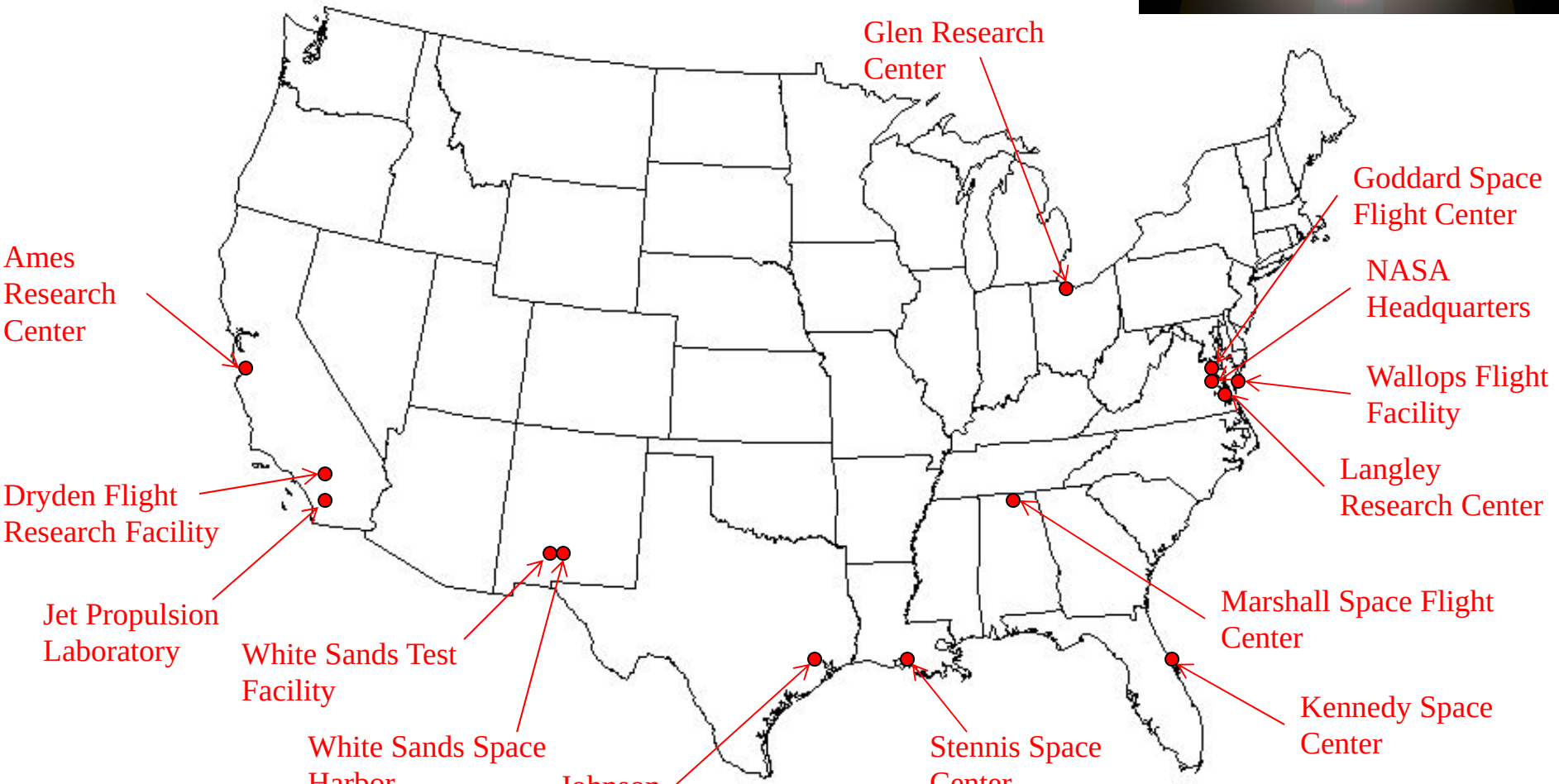
TIM POTTER
NASA TEST DIRECTOR
LANDING RECOVERY DIRECTOR
Launch Complex Operations
Vehicle Processing Directorate
Kennedy Space Center


"The Earth
is the cradle of mankind,
but one cannot live in the cradle forever."
—Konstantine Tsiolkovsky

Where We Work



International Space Station

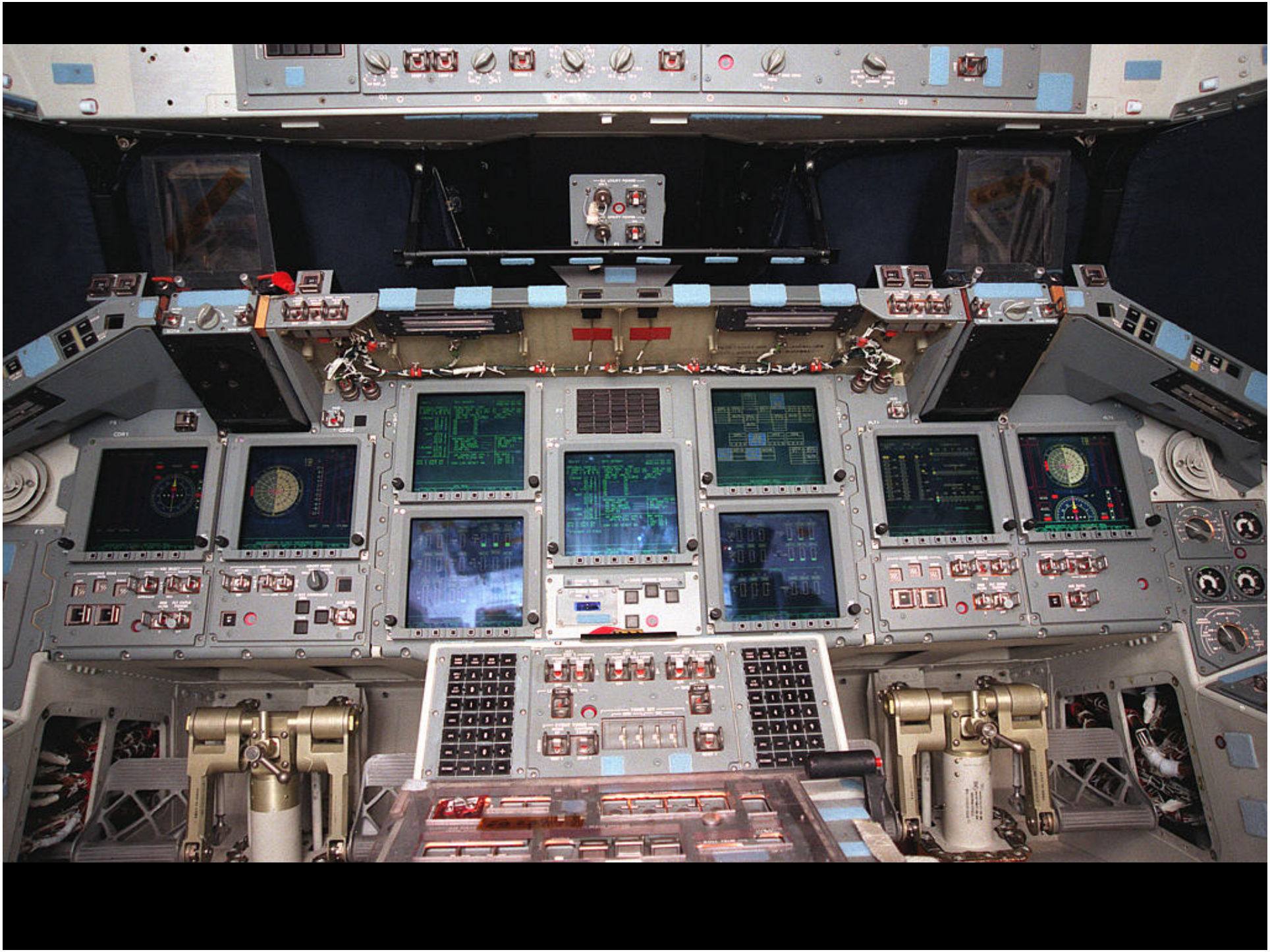


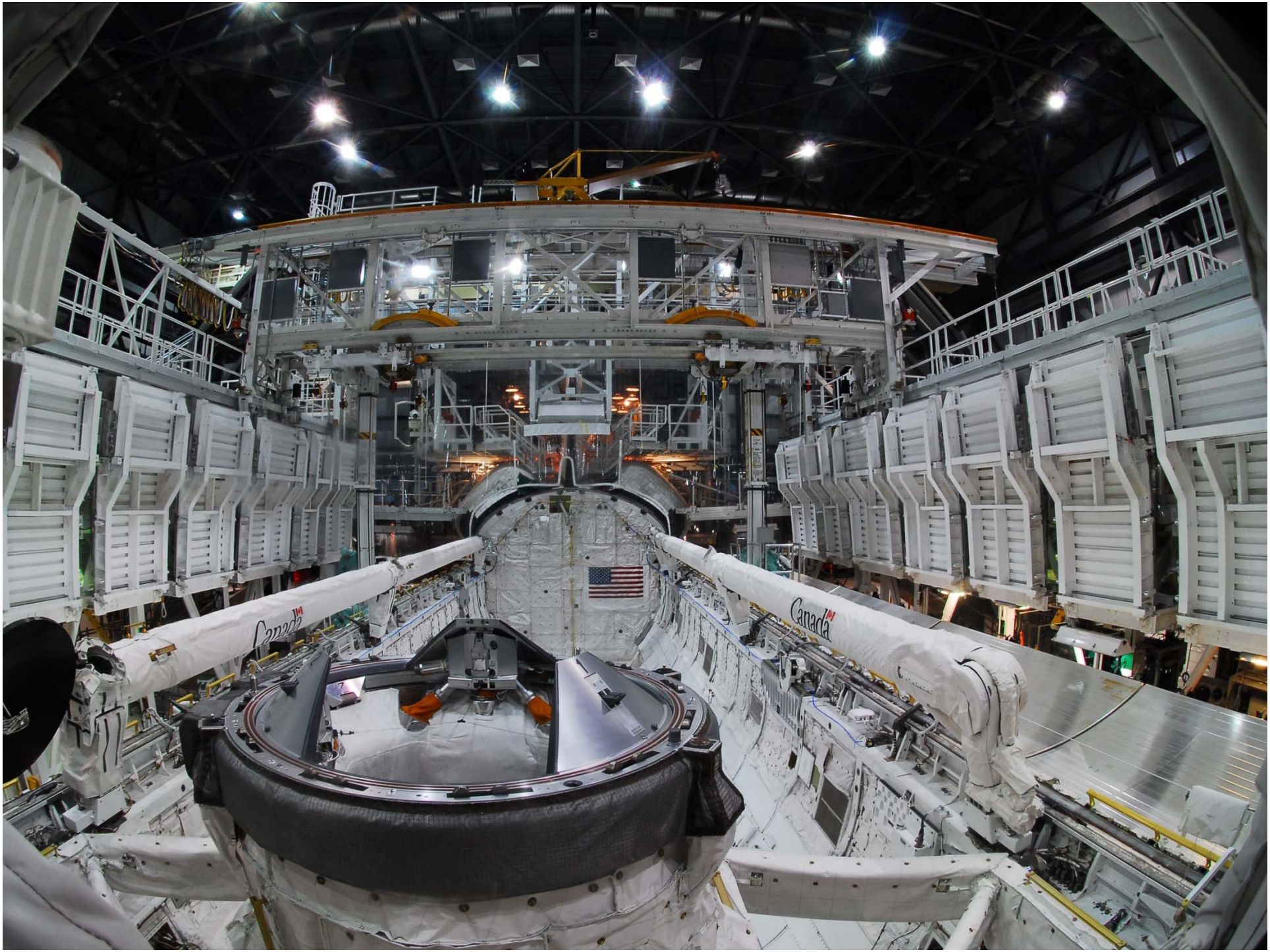
The Space Shuttle Program
The End of an Era
1981 - 2011


NASA
United States
Endeavour


United States

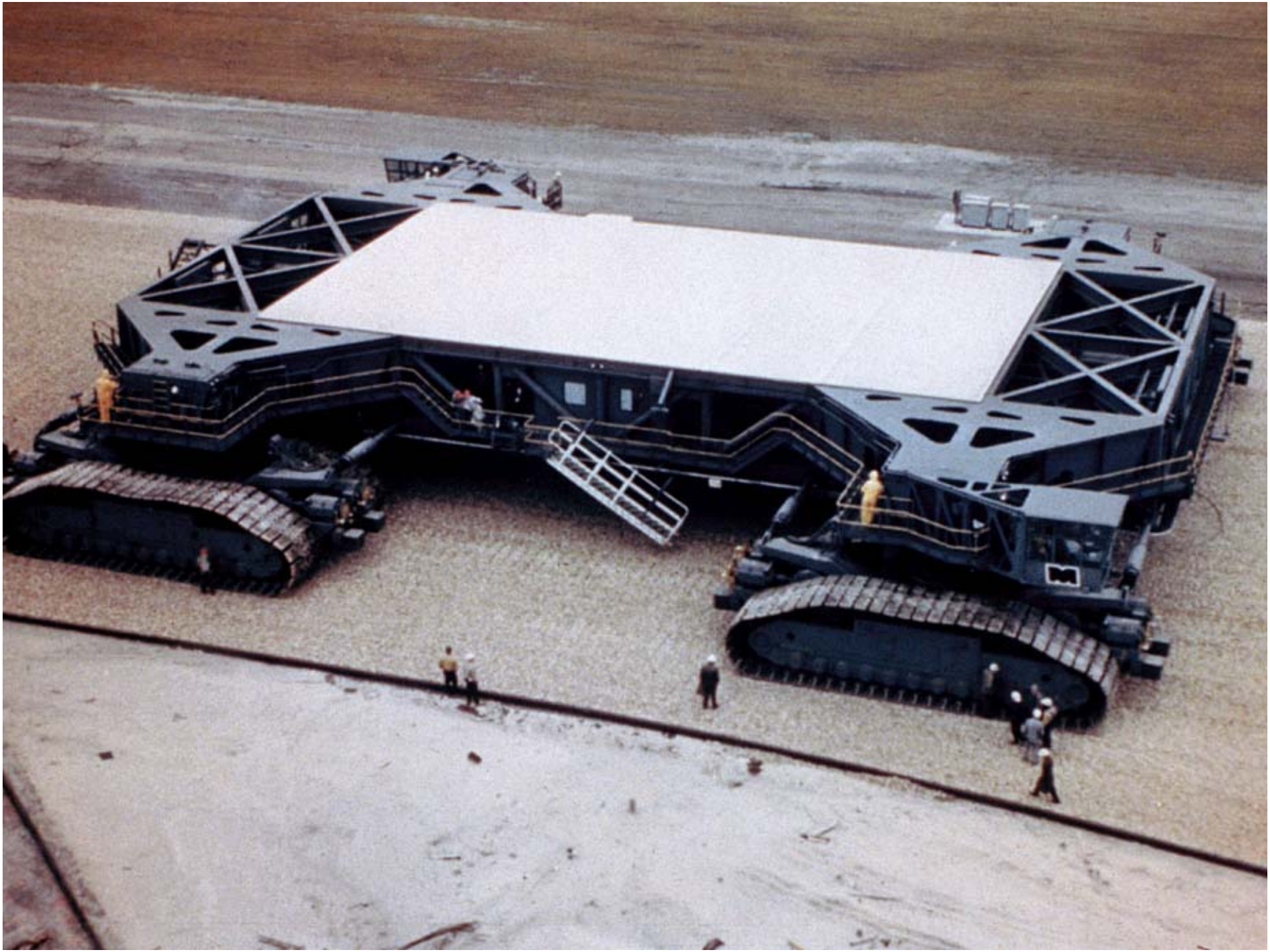

Discovery
HE 402-024

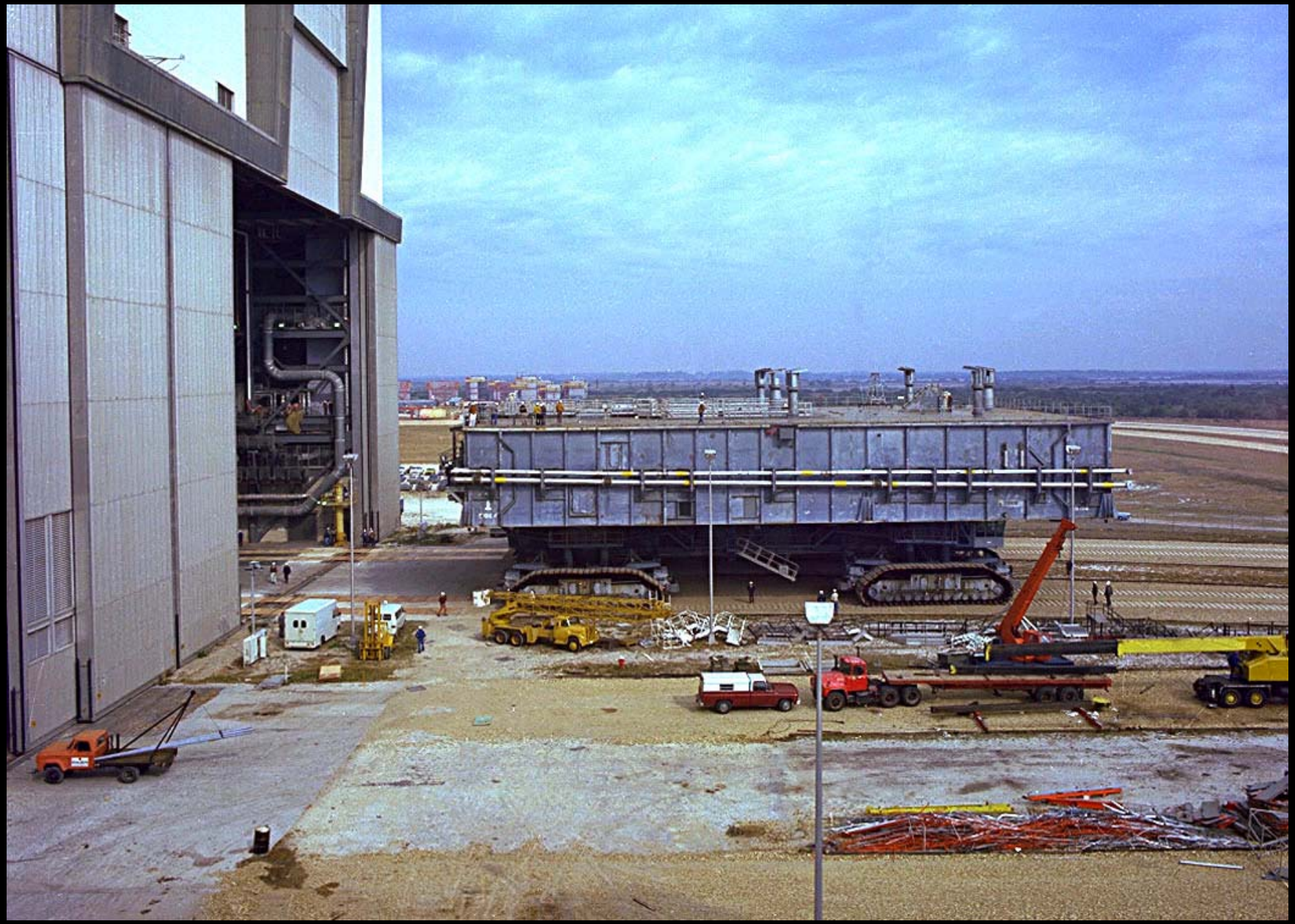



Canada
Canada


HYSTER
ROCKETDYNE


NASA



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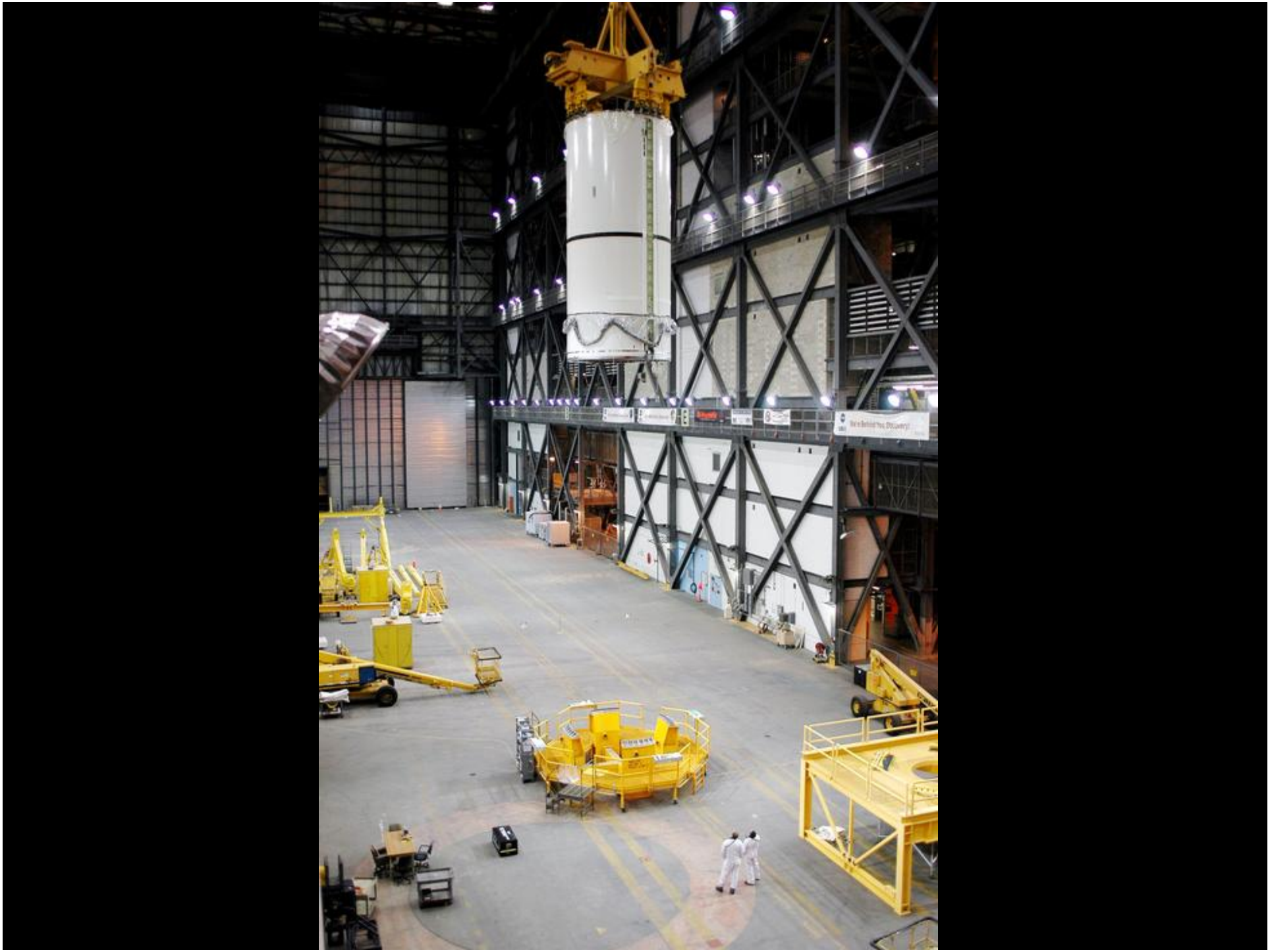
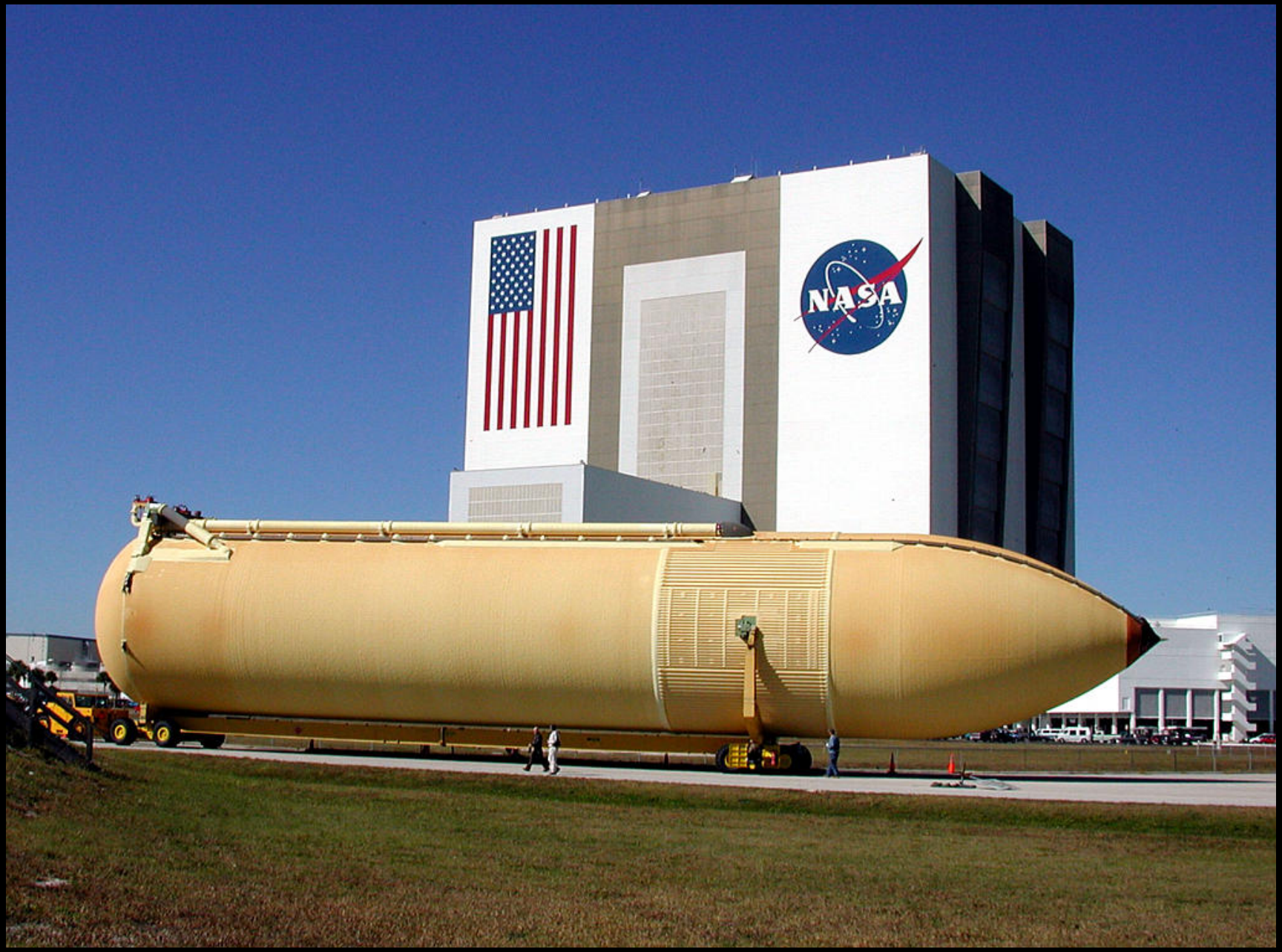
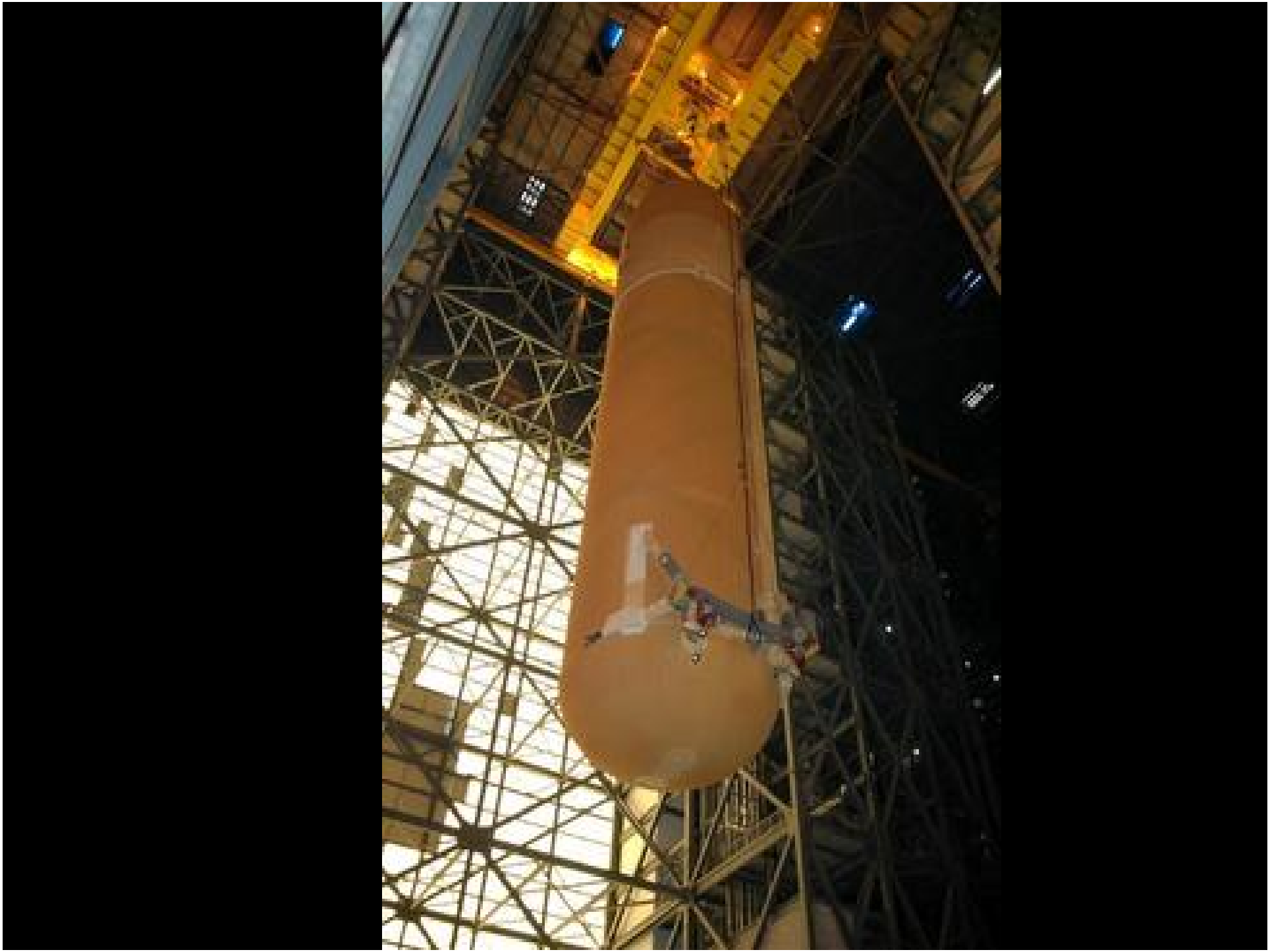
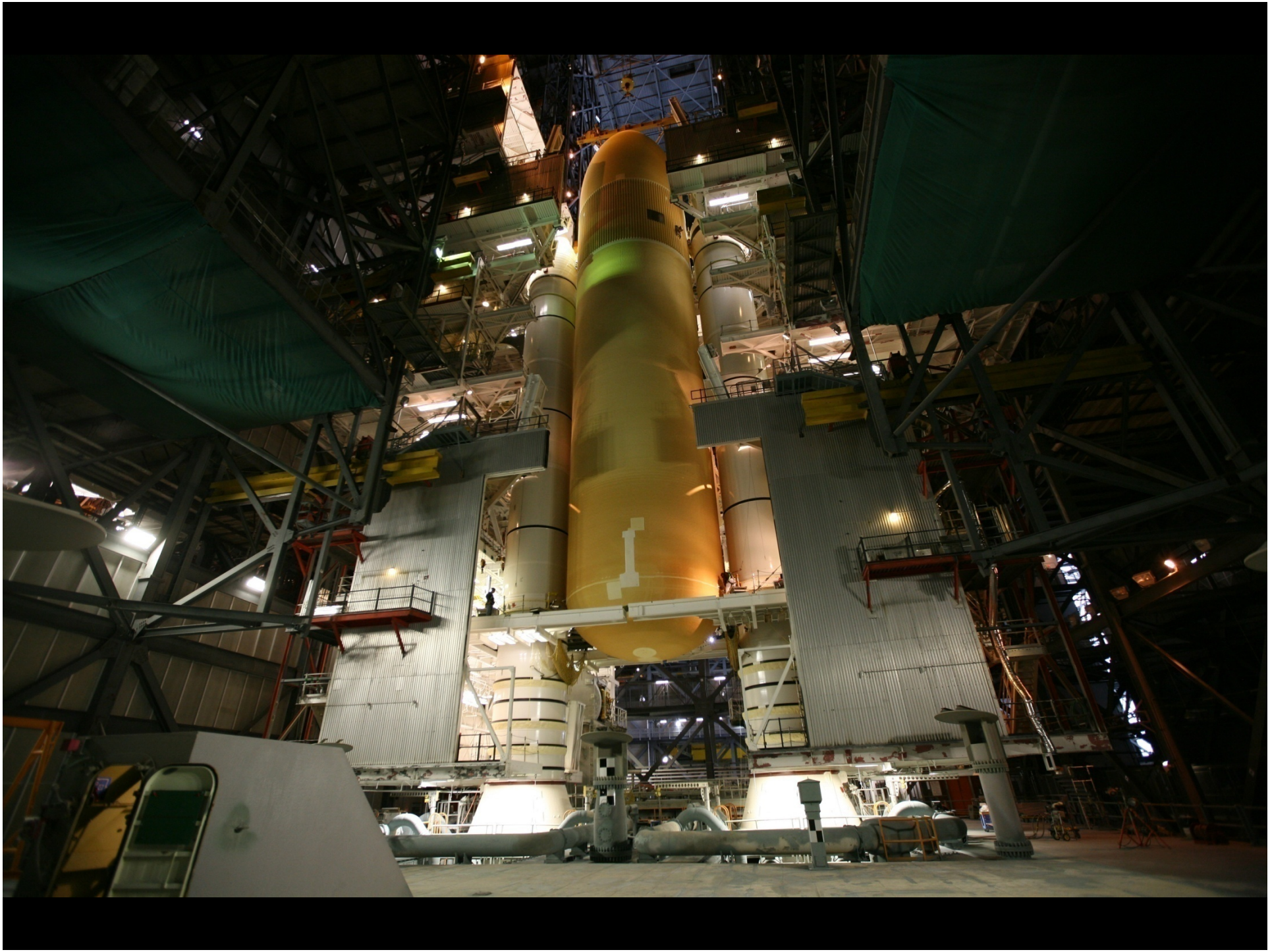



NASA






NASA


Discovery
We're Behind You, Discovery
1


Discovery


Discovery

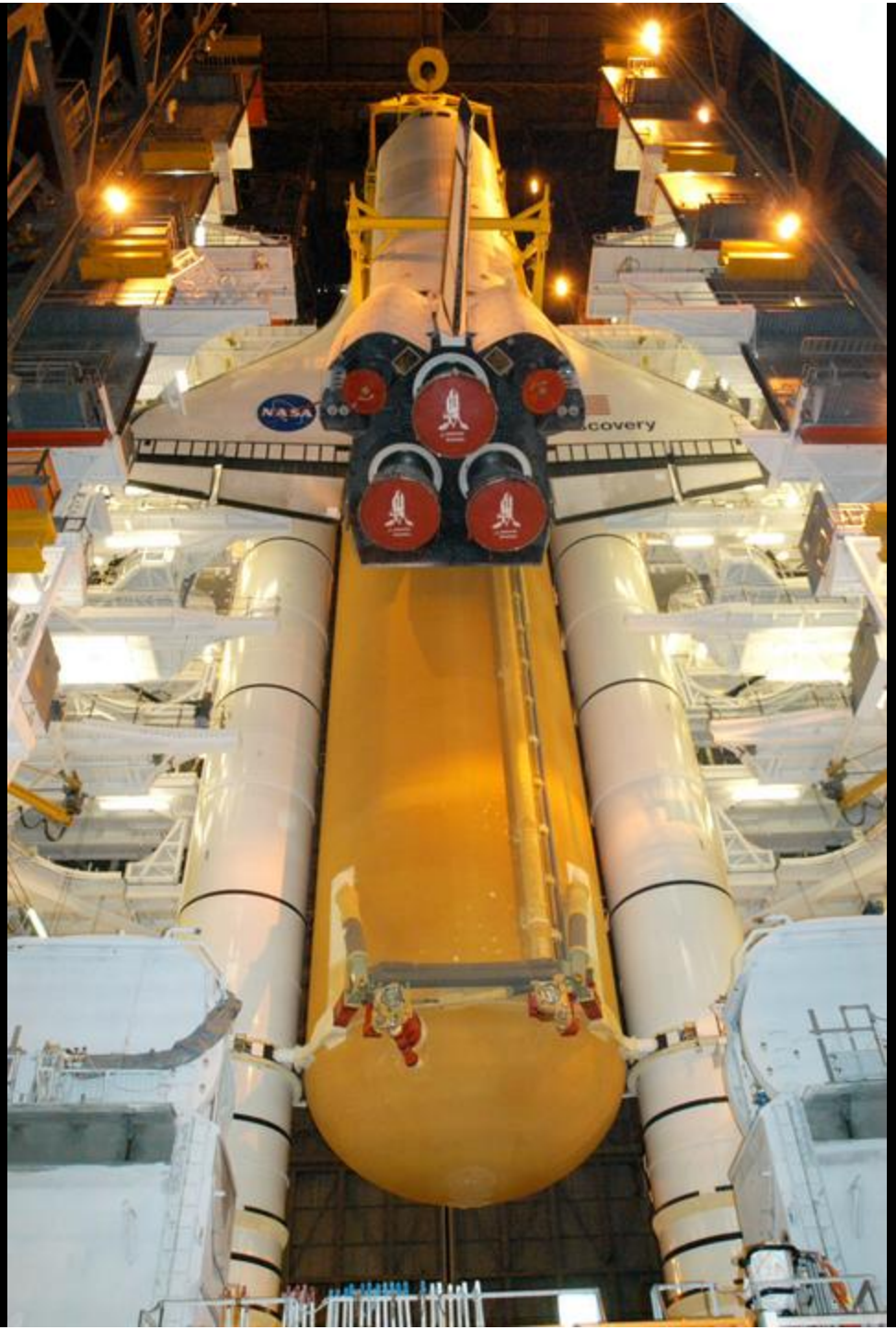

NASA
Discovery


NASA


Discovery
United States


Discovery
United States


Discovery

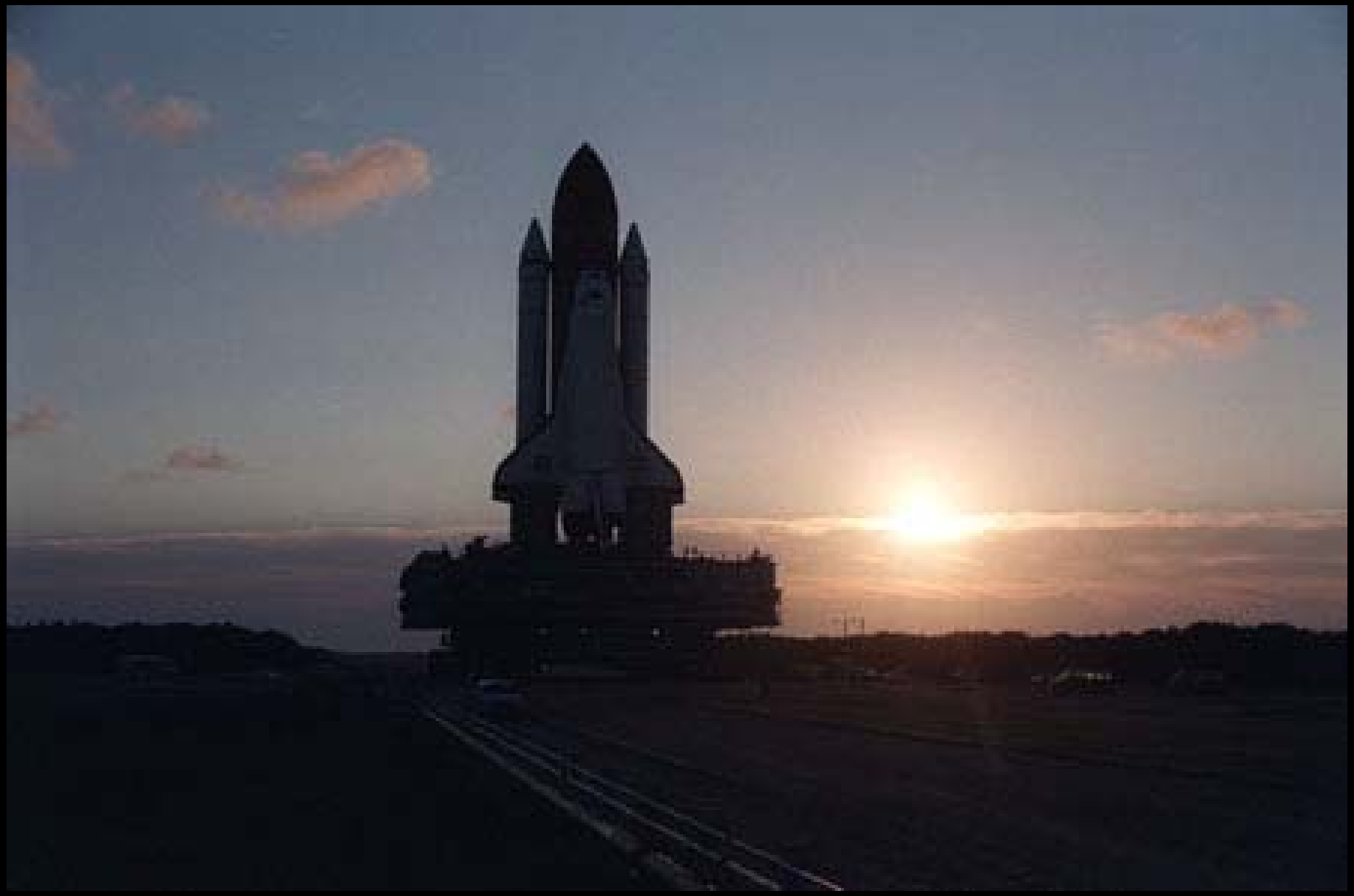

NASA


NASA
covery


Discovery


NASA


United States




USA

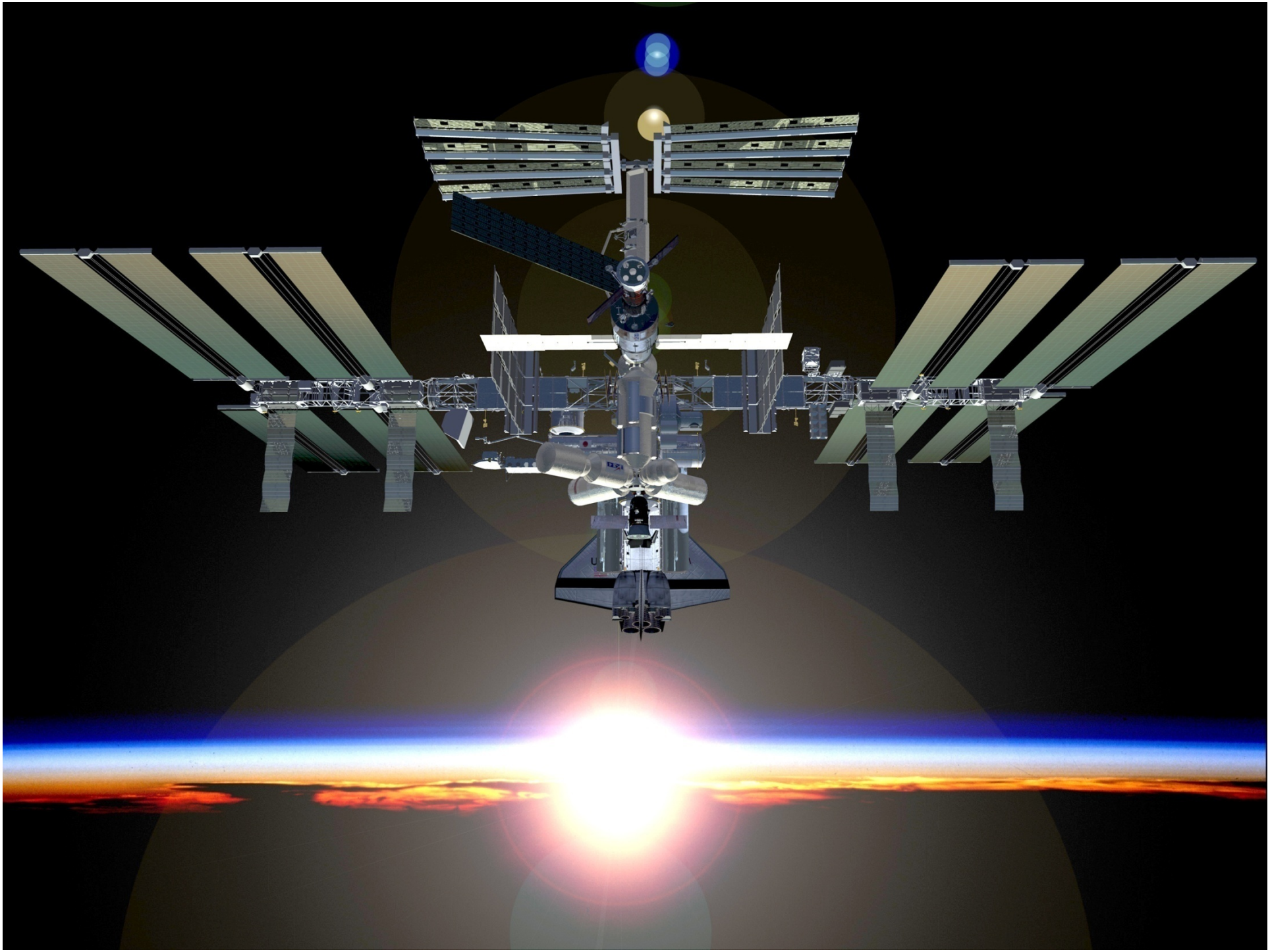

NASA


DISCOVERY
NASA TEST DIRECTOR
ASST. NASA TEST DIRECTOR
CHIEF NASA TEST DIRECTOR
LANDING RECOVERY DIRECTOR
PAYLOAD TEST DIRECTOR
PAYLOAD TEST CONDUCTOR
FLIGHT SURGEON
NASA KSC MEDICAL
INSTRUMENTATION
LANDING RECOVERY DIRECTOR


USA

S120E005003


Columbia
Challenger
Discovery
Atlantis
Endeavour
LANDING RECOVERY DIRECTOR
ASST. NASA TEST DIRECTOR




Discovery


Atlantis
Canada
esa

Belgium

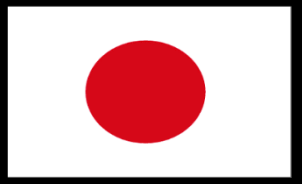
Brazil

France

Spain

The Netherlands

Germany



Japan

Sweden

Denmark

Canada

Switzerland

Norway

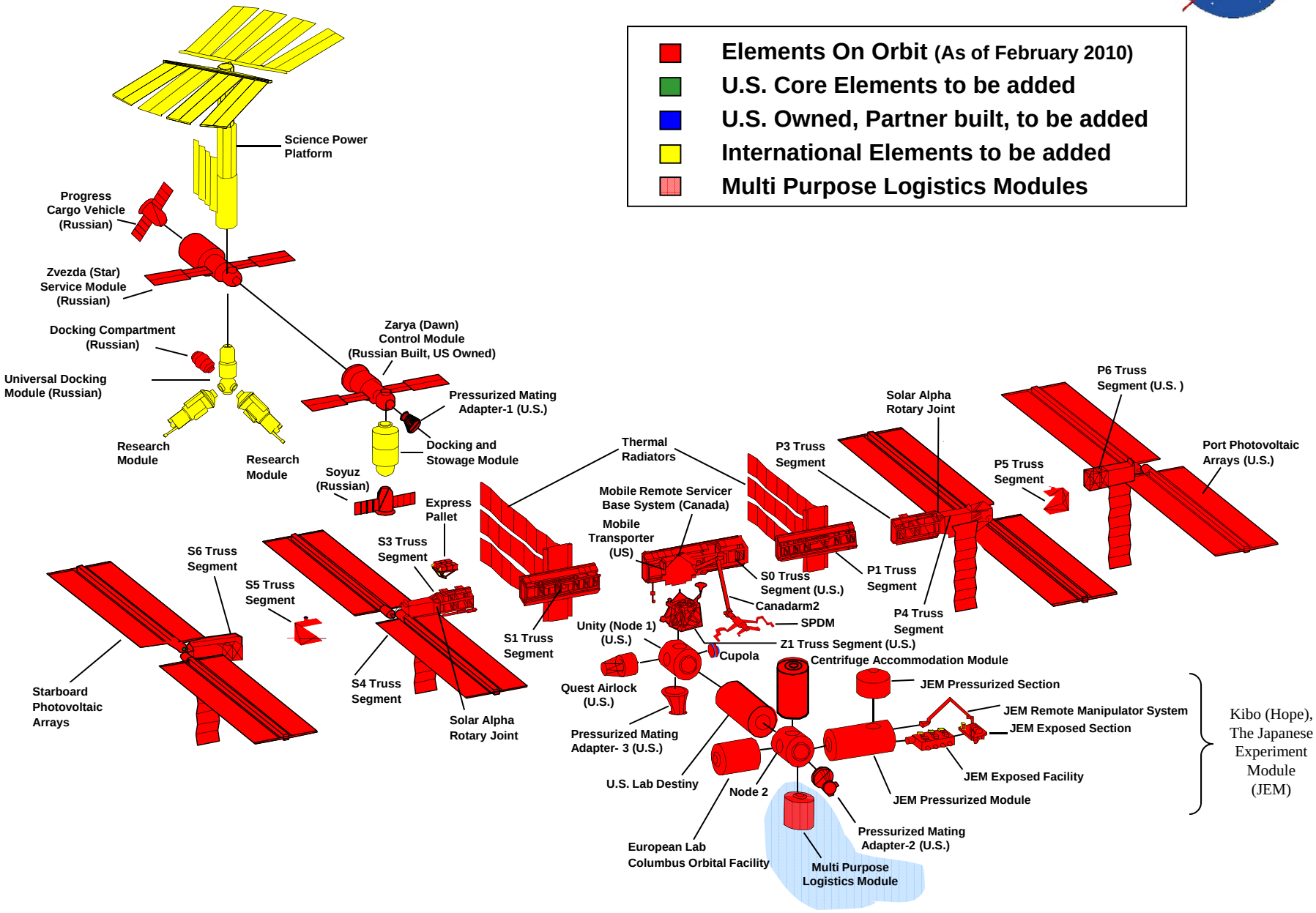
Italy

Russia

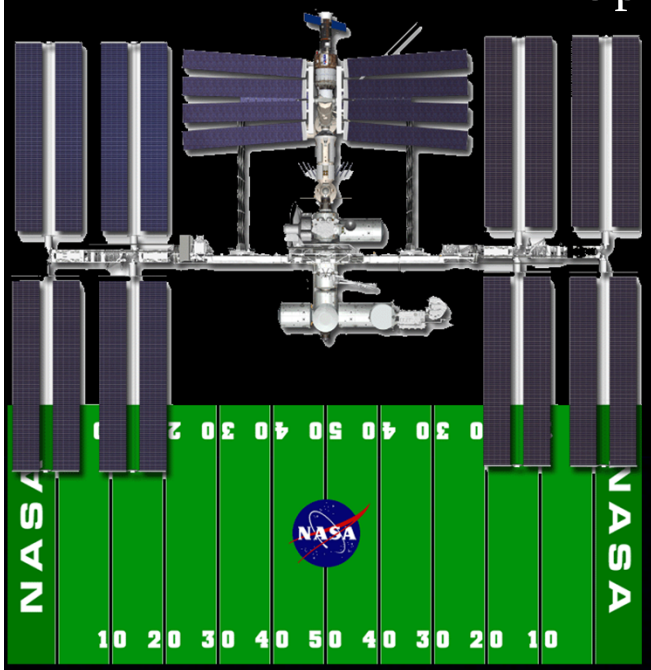
United Kingdom

United States

International Space Station



Overview & Capabilities



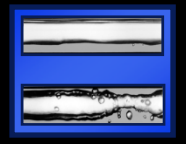
Wingspan End-to-End	--	361 feet
Operating Altitude	--	220 nautical mile average
Length	--	290 feet (79.9 meters)
Weight	--	1,005,000 pounds (at completion)
Inclination	--	51.6 degrees to the equator
Volume	--	46,000 cubic feet of pressurized living
Crew	--	6 people at assembly complete
Atmosphere	--	14.7 pounds per square inch (same as Earth)

Research Disciplines on ISS


Biomedical Research

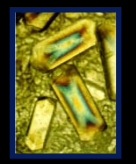

Fundamental Biology


Combustion Science

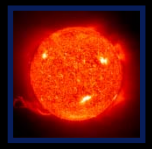

Fluid Physics


Materials Science

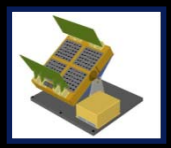

Fundamental Physics


Biotechnology Research


Earth System Science

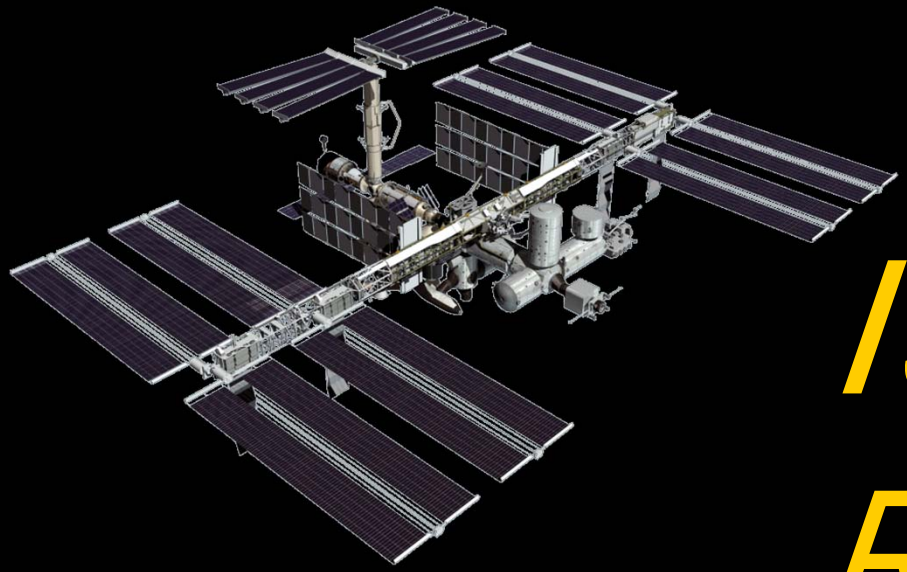

Space Science


Advanced Human Support Technology


Engineering Research


Space Commerce

Space Station Research covers a broad range of disciplines

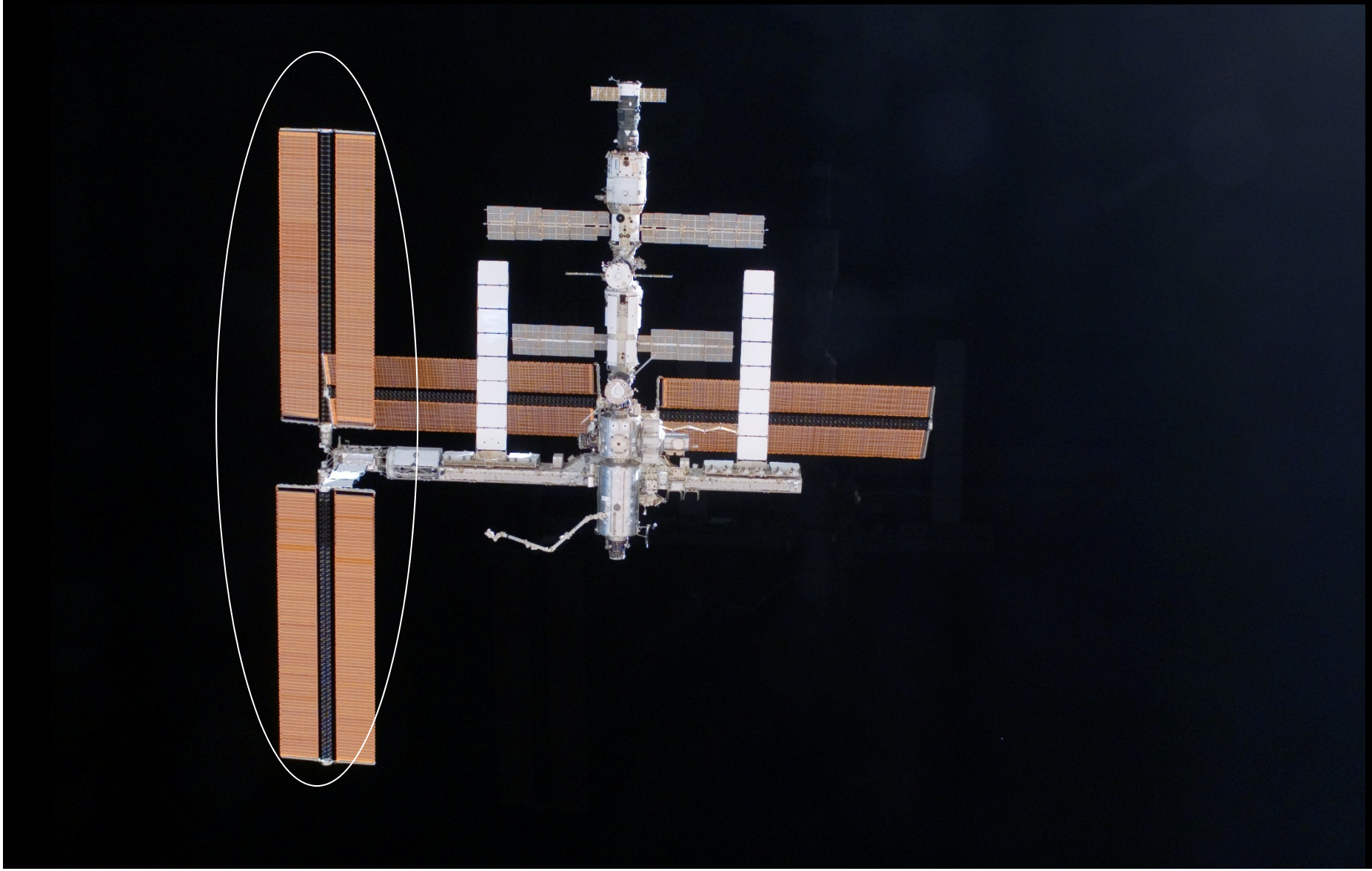


ISS Since Return to Fight

STS-115

Installation of the P3/P4 Array Truss Structure

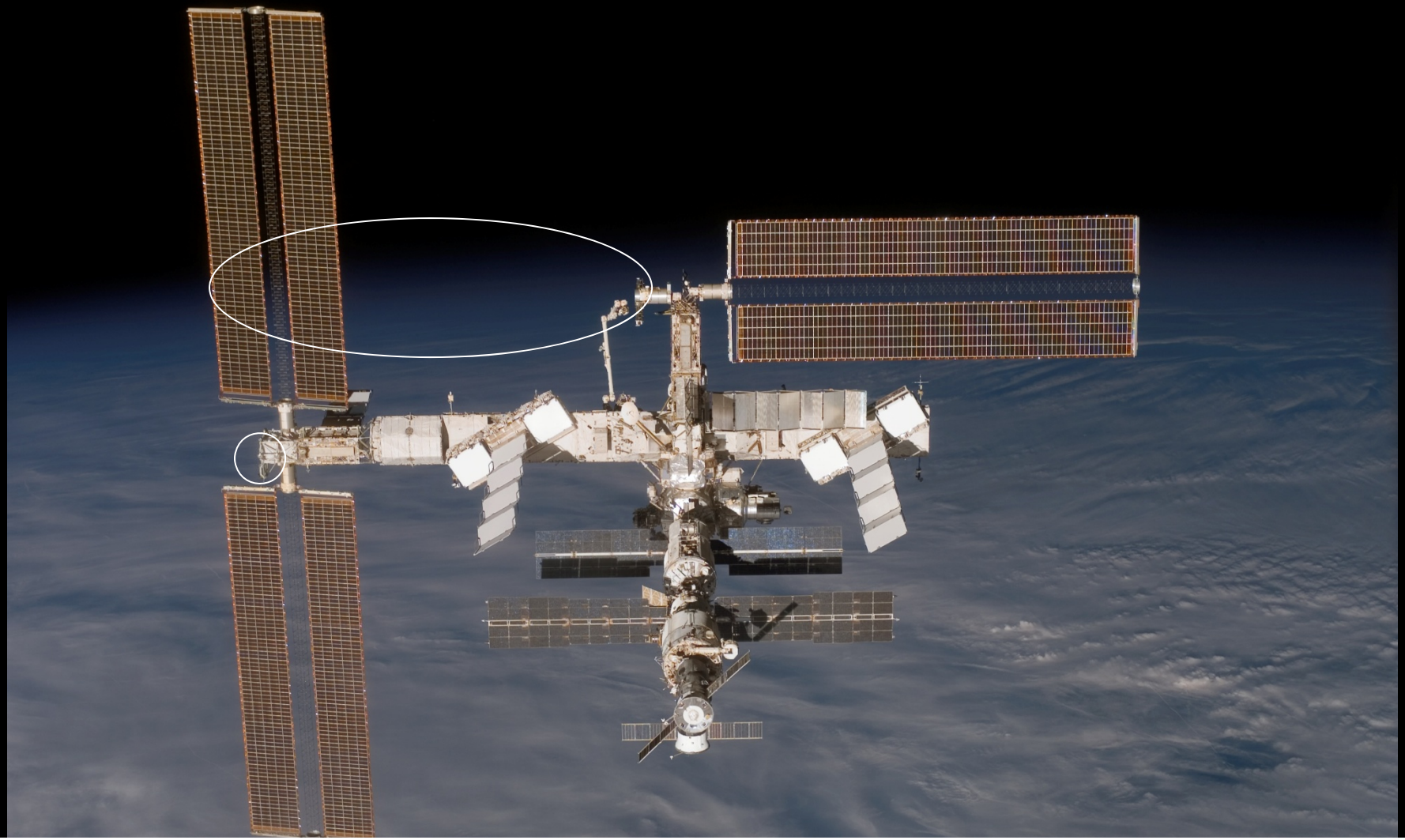
September 17, 2006



STS-116

December 19, 2006

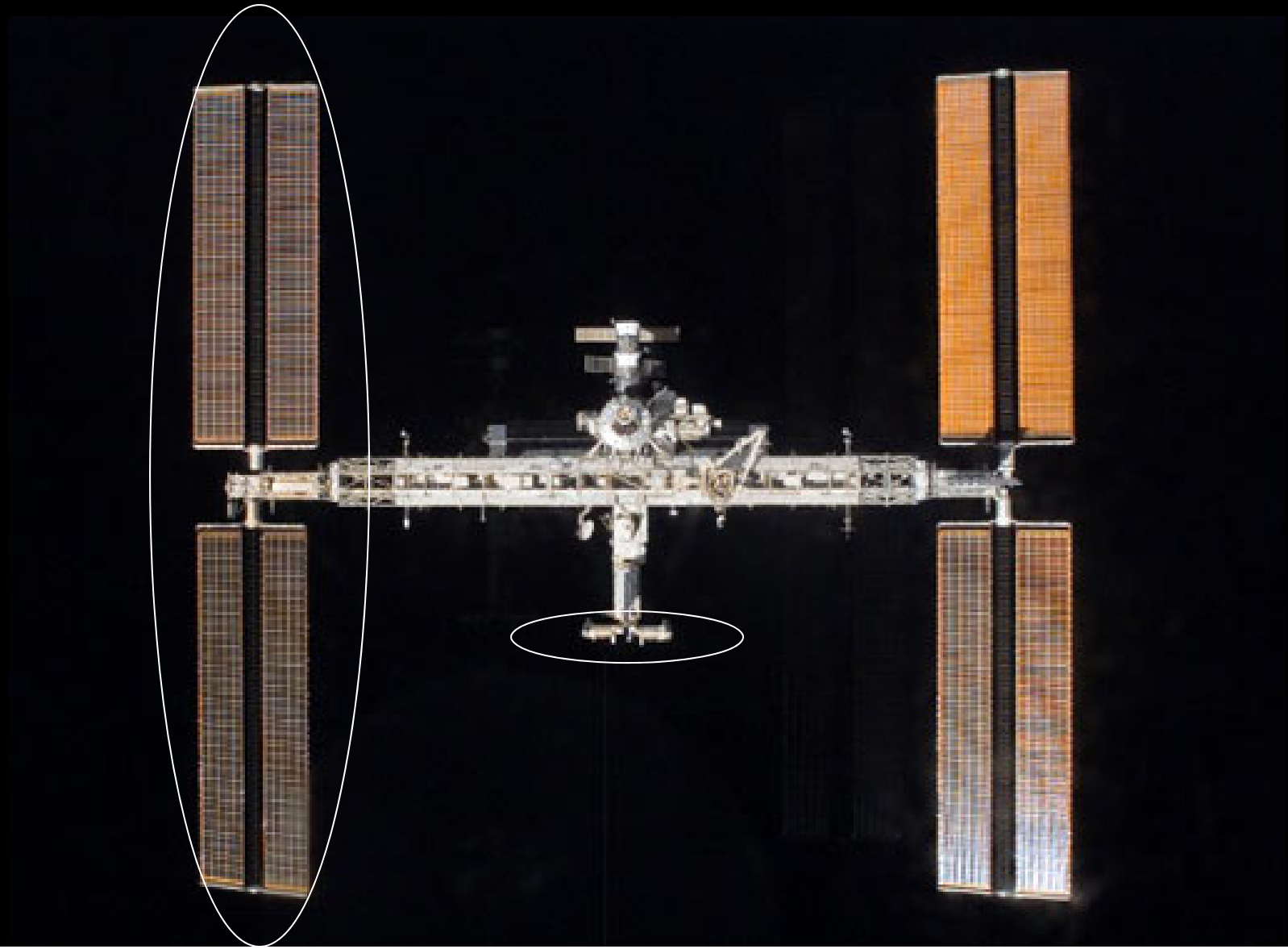
Installation of the P5 truss and retraction of half the P6 Truss Structure and activation of the new power control system



STS-117

June 8, 2007

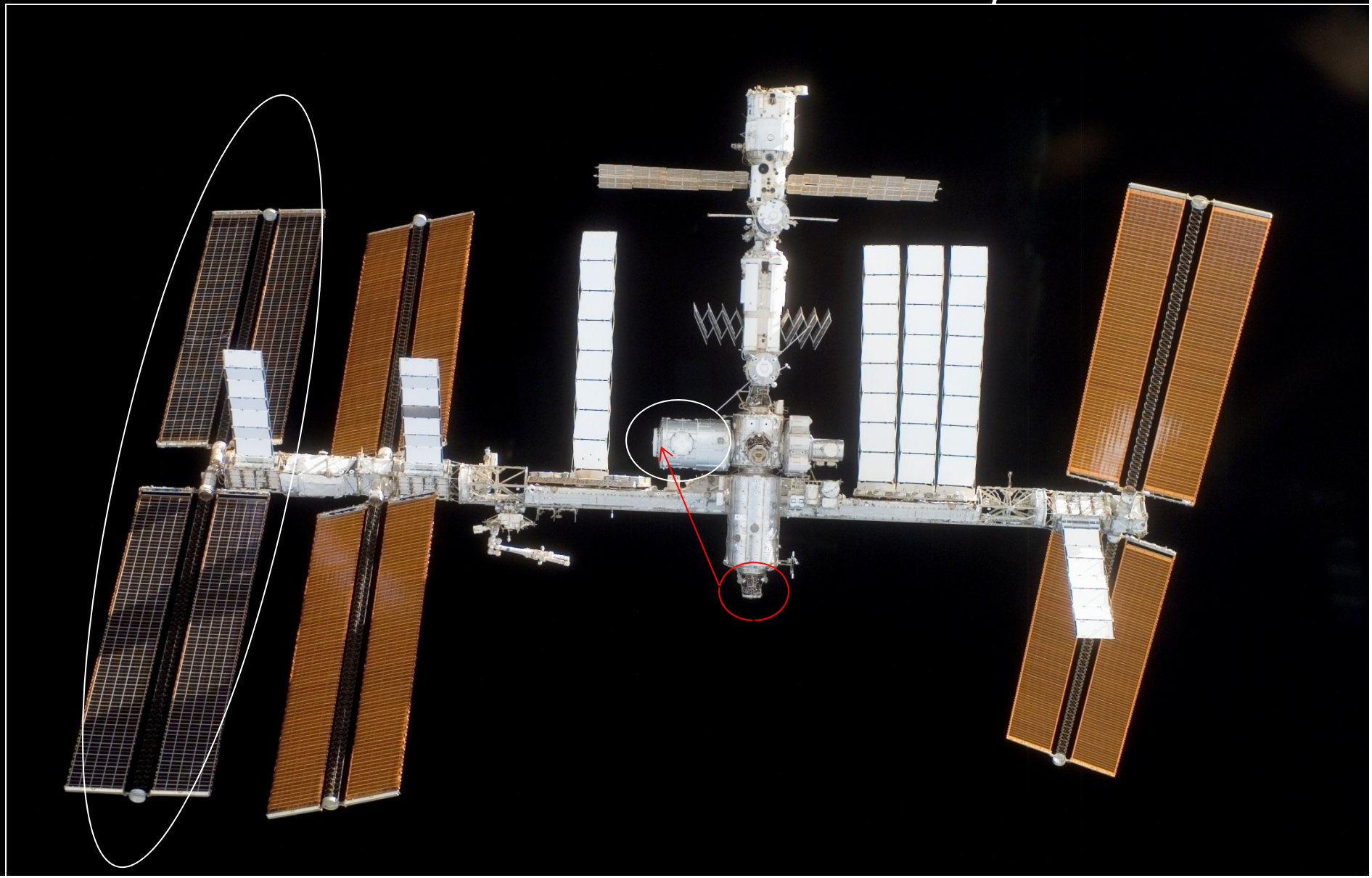
Installation of the S3/S4 truss and retraction of the other half of the P6 Truss Structure



STS-120

Installation of Node 2 (Harmony) and reposition the P6 Truss Structure

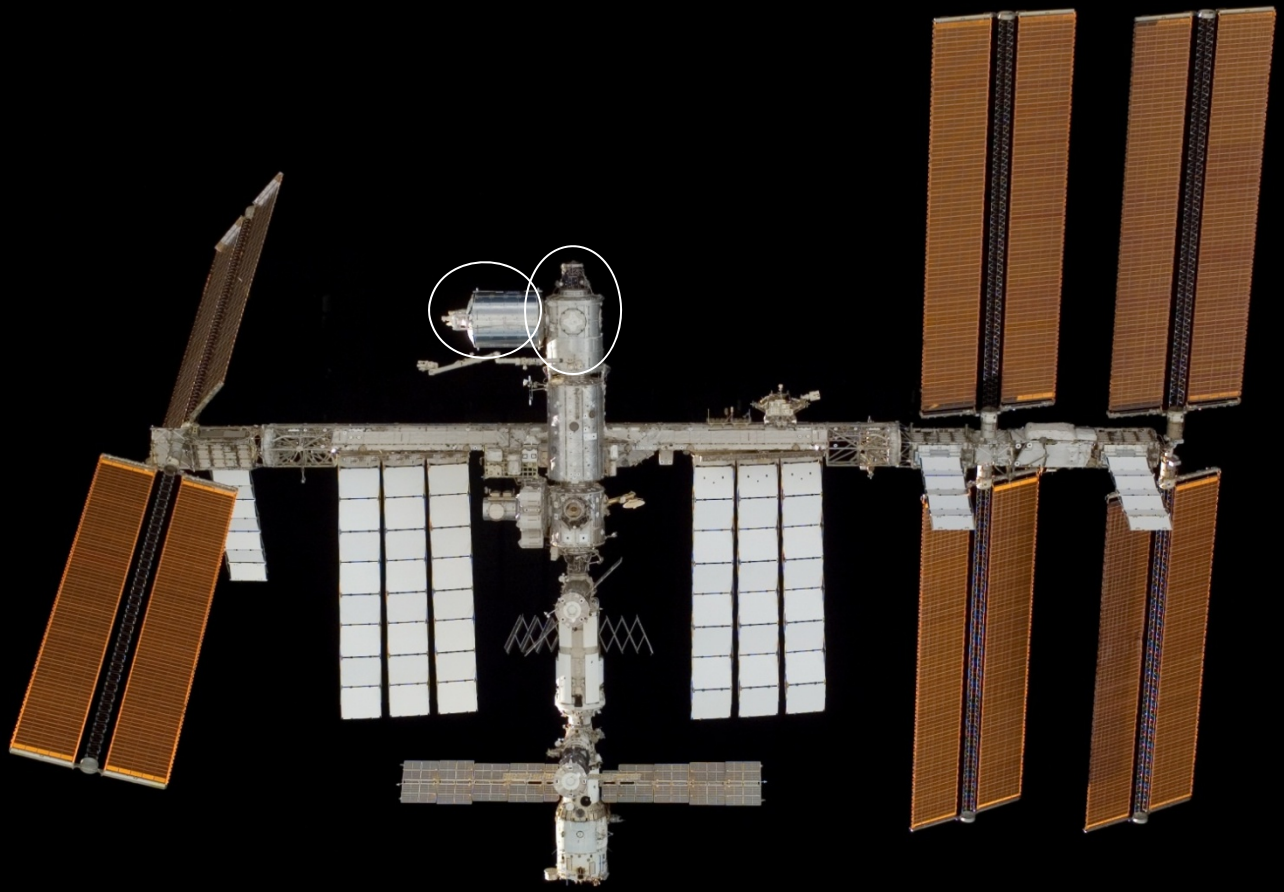
October 23, 2007



STS-122

Movement of PMA 1 and Node 2 to the end of the U.S. Lab and Installation and outfitting of the European Space Agency's Columbus Laboratory

February 7, 2008



STS-123

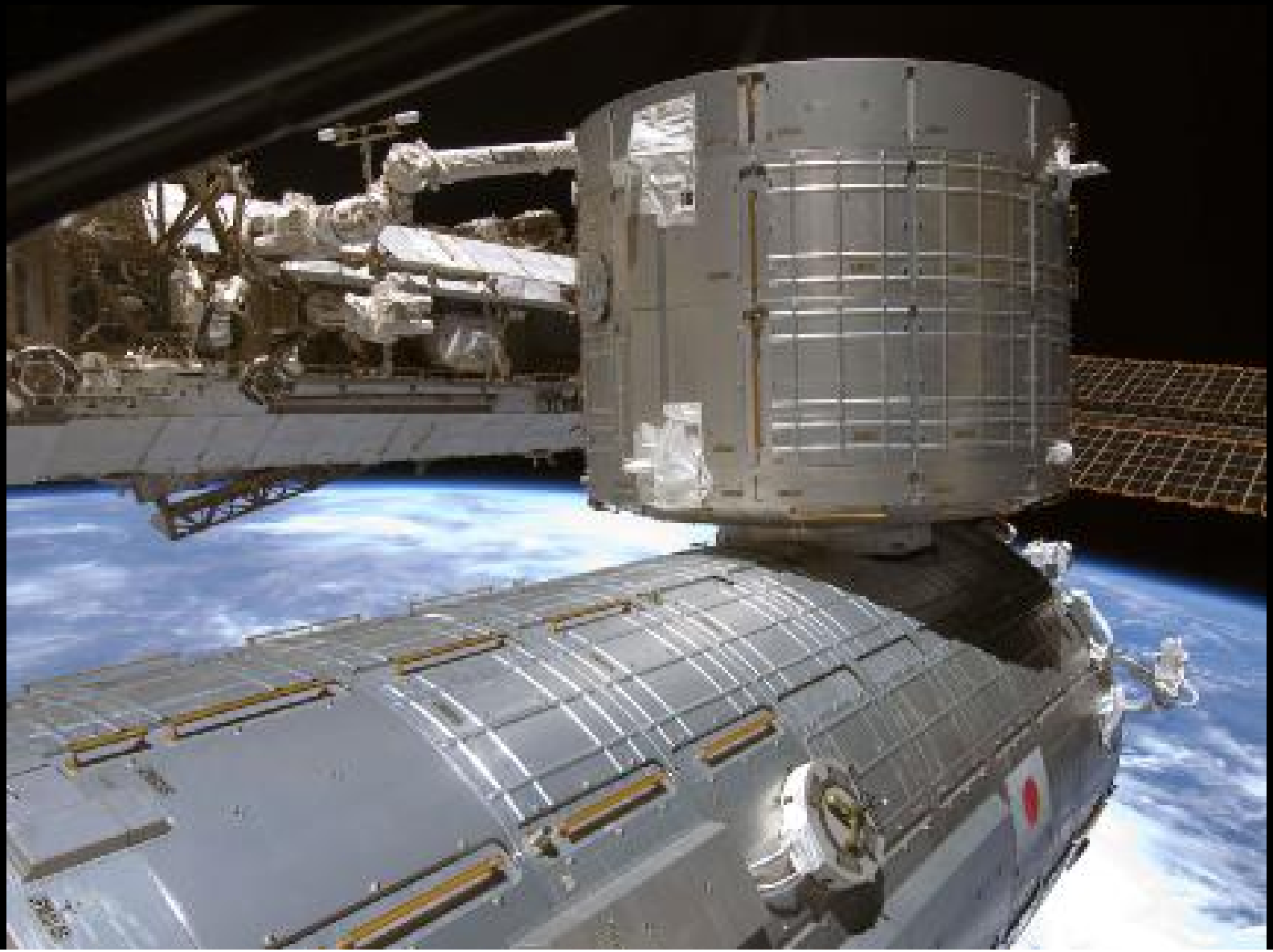
Installation of Japanese Space Agency's Kibo Logistics Module and the Canadian Space Agency's Dextre Robotics System

March 11, 2008

STS-124

Installation of Japanese Space Agency's Pressurized Laboratory Module (Hope)

May 31, 2008



STS-119

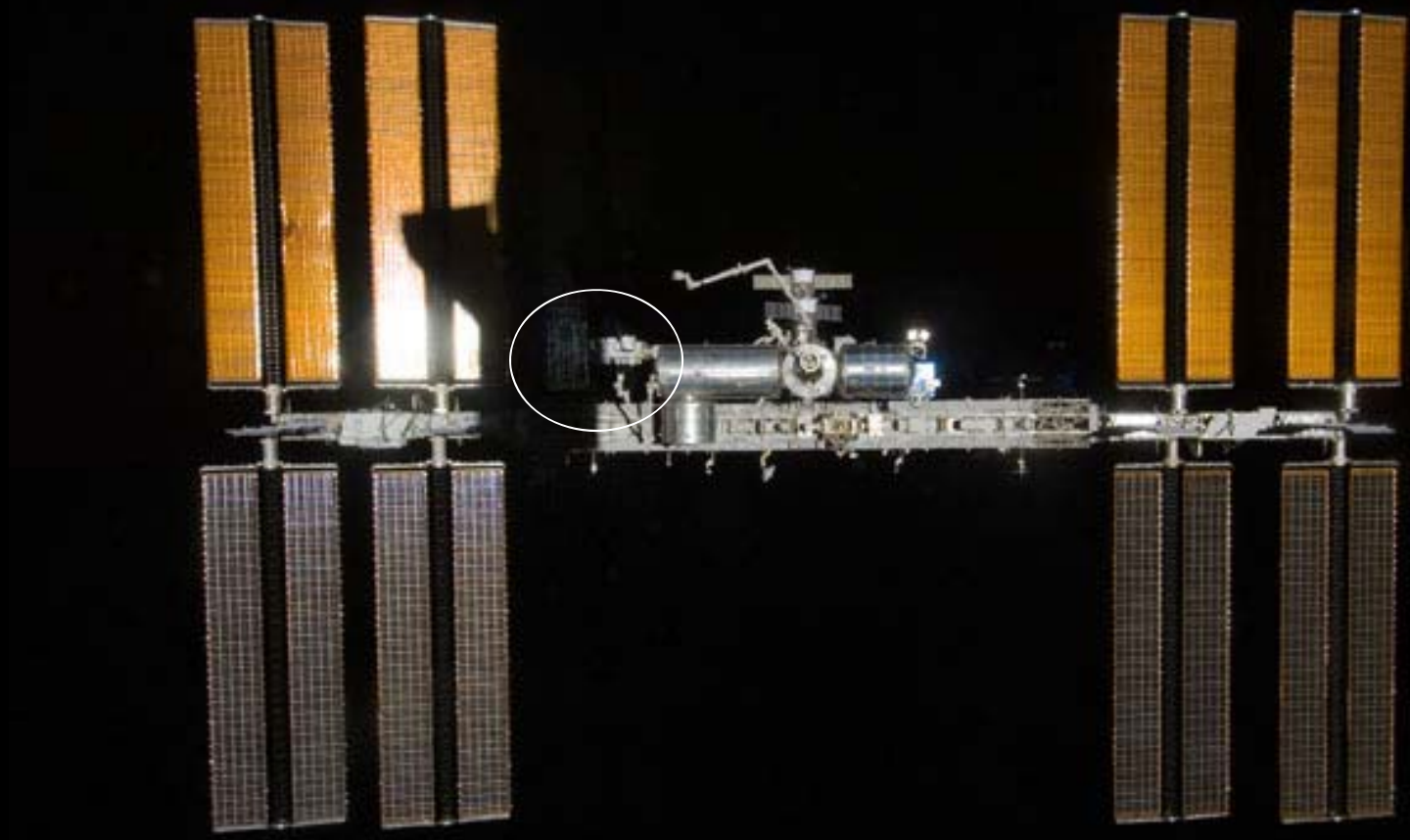
March 15, 2009

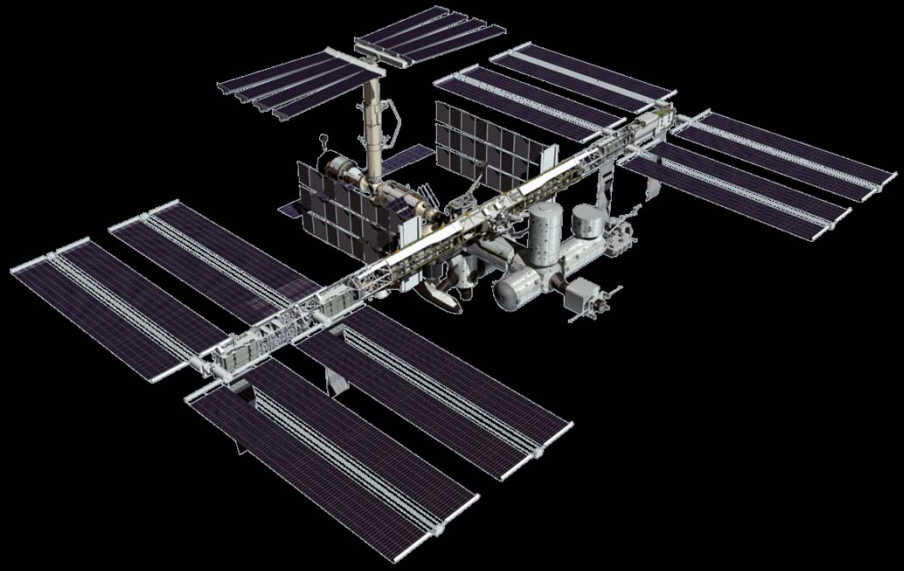
Installation of S6, the final set of solar arrays enabling bringing the crew size to 6

STS-127

Installation of Japanese Space Agency's Kibo Laboratory Exposed Facility and Experiment Packages

July 28, 2009



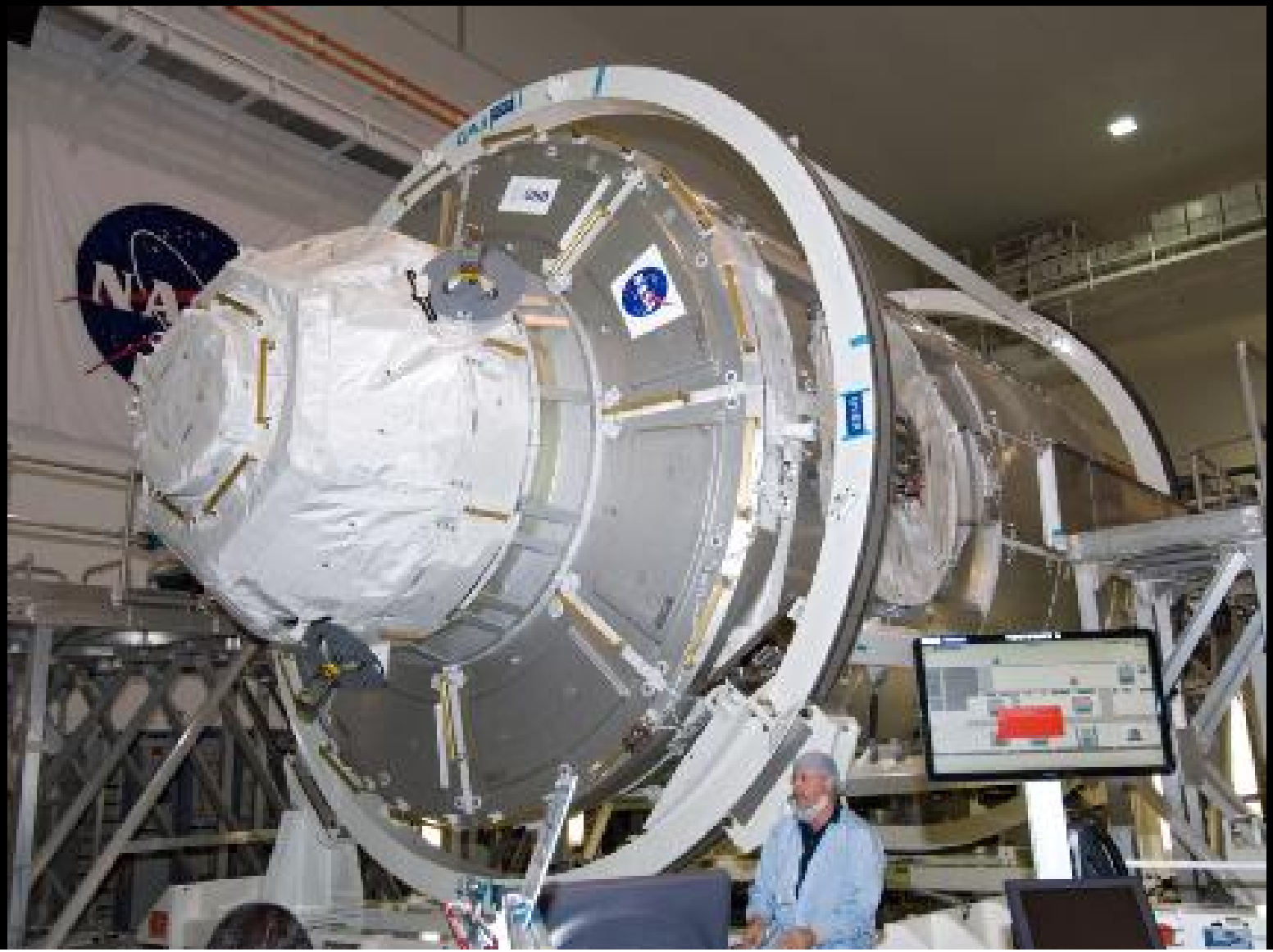


STS-130 Continuing the Construction

STS-130

February 8, 2010

Installation of Node 3, Tranquility, with its Cupola providing windows on the world



STS-130

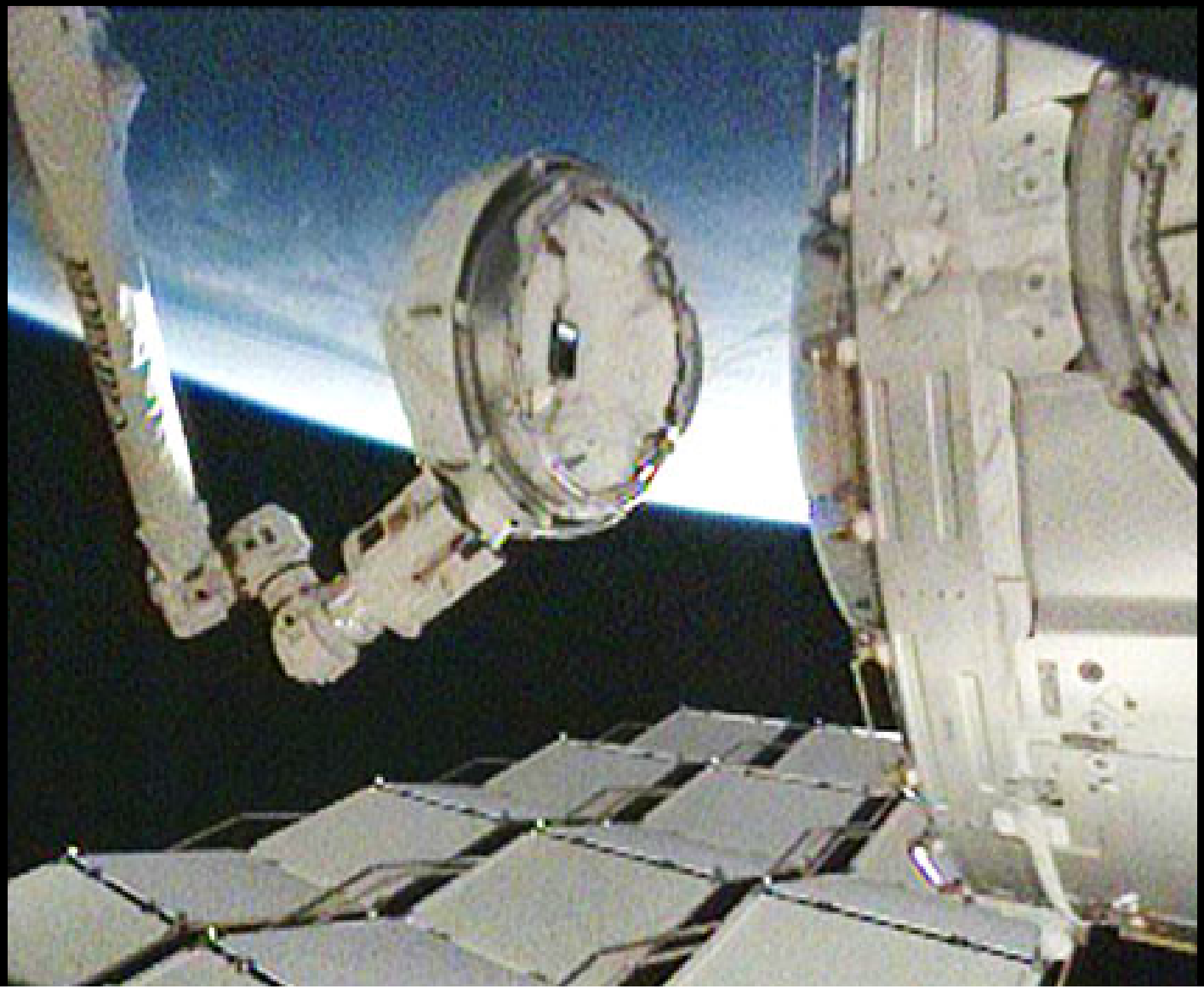
February 12, 2010

Location of Node 3, Tranquility

STS-130

Relocation of the cupola from the end port to the nadir port of Node 3, Tranquility

February 14, 2010



Thirty Expeditions on Orbit

Expedition 30 Crew

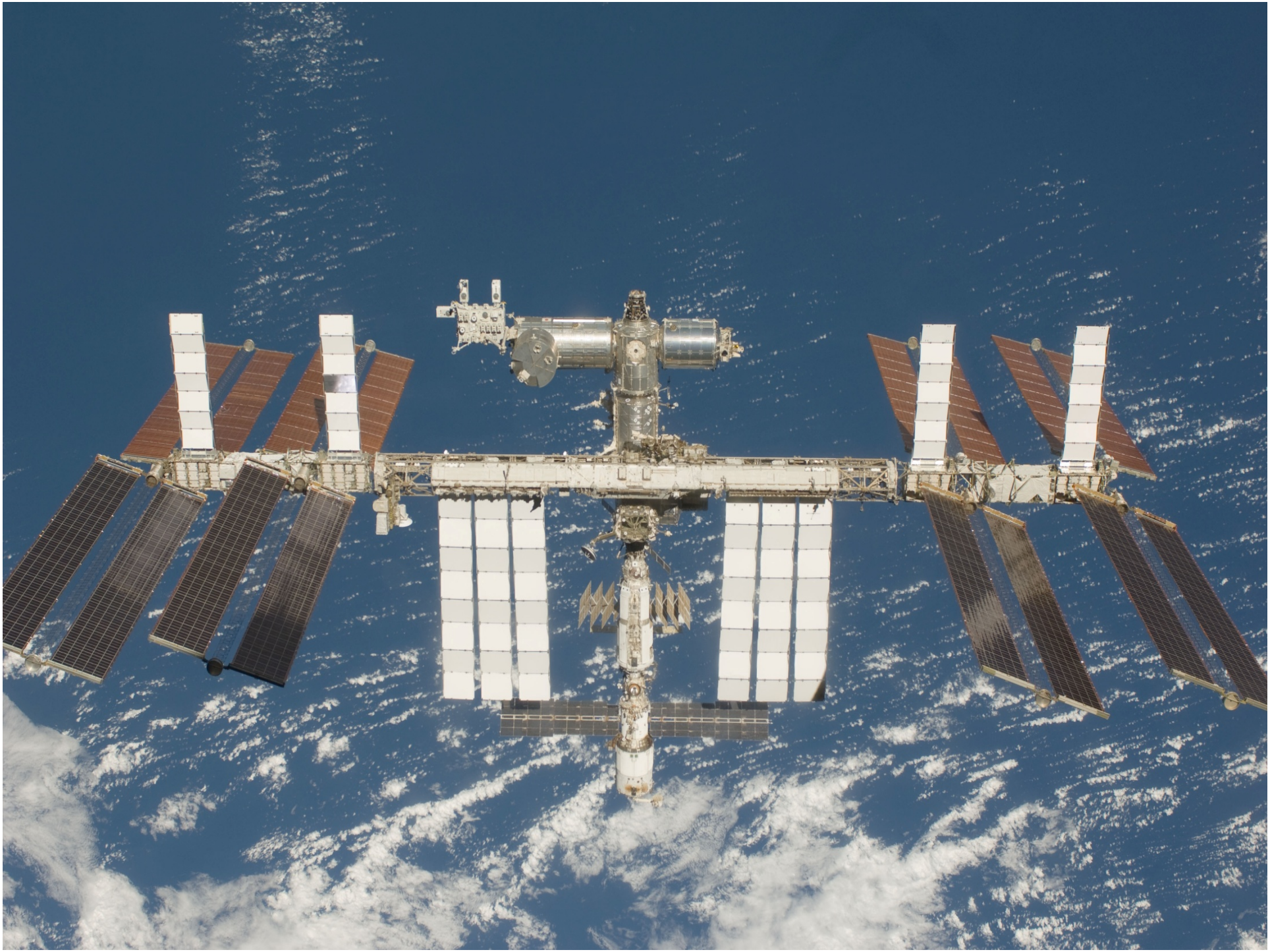
Dan Burbank, Commander; Oleg Kononenko, Anton Shkaplerov, Anatoly Ivanishin, Andre Kuipers, and Don Pettit, Flight Engineers

November 2011 – April 2012 and December 2011 – July 2012

To Date, Permanent Human Presence on Orbit:
4159 Days or 11.39 Years.

Interesting Facts

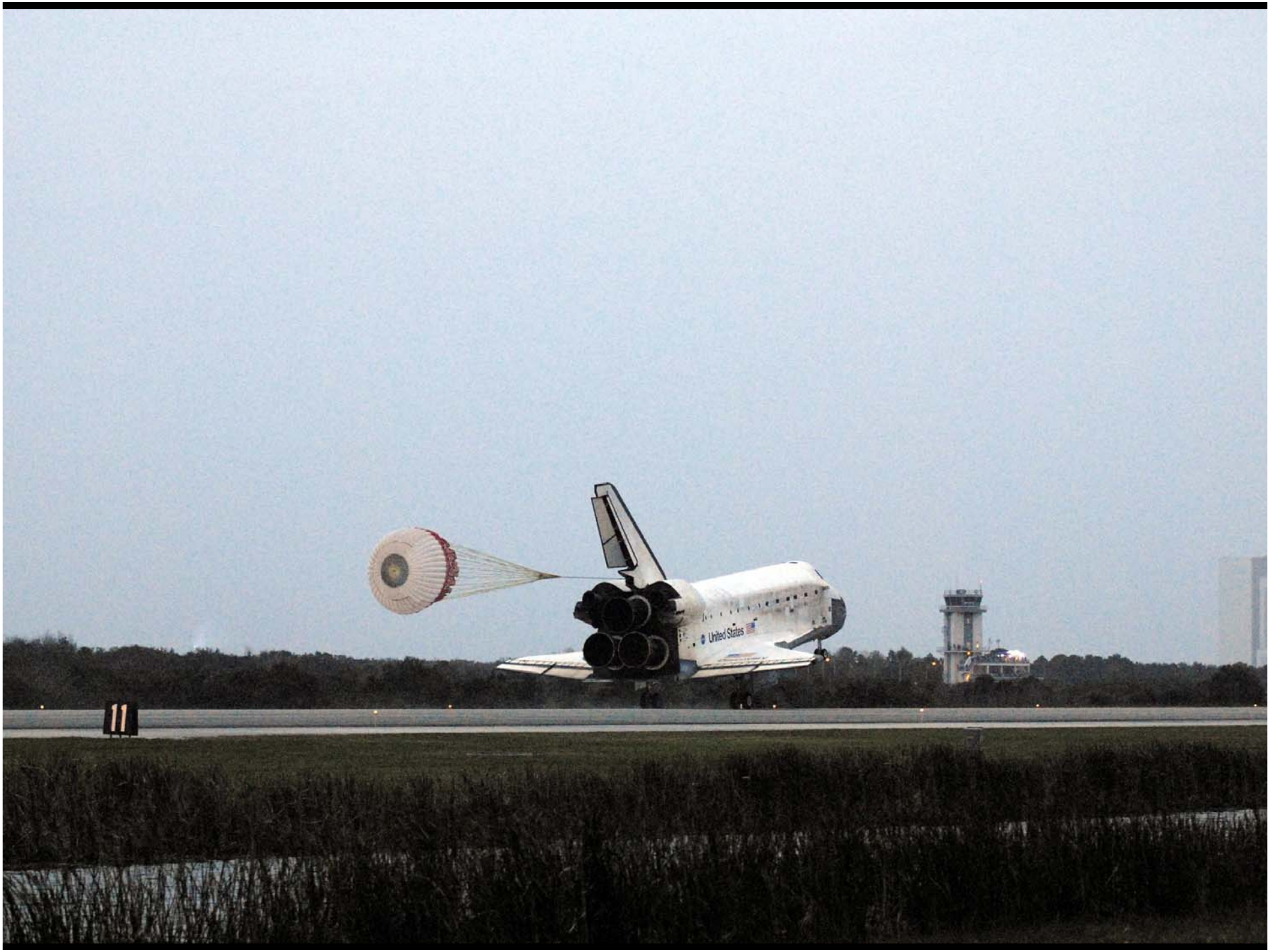
- The Space Station marked 10 years of permanent human presence in November 2010. At that time 202 individuals had visited the orbiting outpost.
- At that time the Station's odometer read 1.5 billion miles, the equivalent of 8 round trips to the sun.
- As of August 2011, there had been 135 launches to the Space Station since the launch of the first module, Zarya, on Nov. 20, 1998:
  - 74 Russian vehicles
  - 37 Space Shuttles
  - two European vehicles
  - two Japanese vehicles
  - The final Space Shuttle mission July 8-21, 2011 by Atlantis delivered 4 1/2 tons of supplies in the Raffaello logistics module.
- A total of 161 spacewalks have been conducted in support of space station assembly totaling more than 1,015 hours.
- The complex now has more livable room than a conventional five-bedroom house (~43,000 cu. Ft.), and has two bathrooms, a gymnasium and a 360-degree bay window.
- The Station's current Mass is 861,804 lb. (390,908 kilograms) and is expected to grow to almost 1 million lbs.
- The Station's 8 solar arrays produce approximately 84 kilowatts.

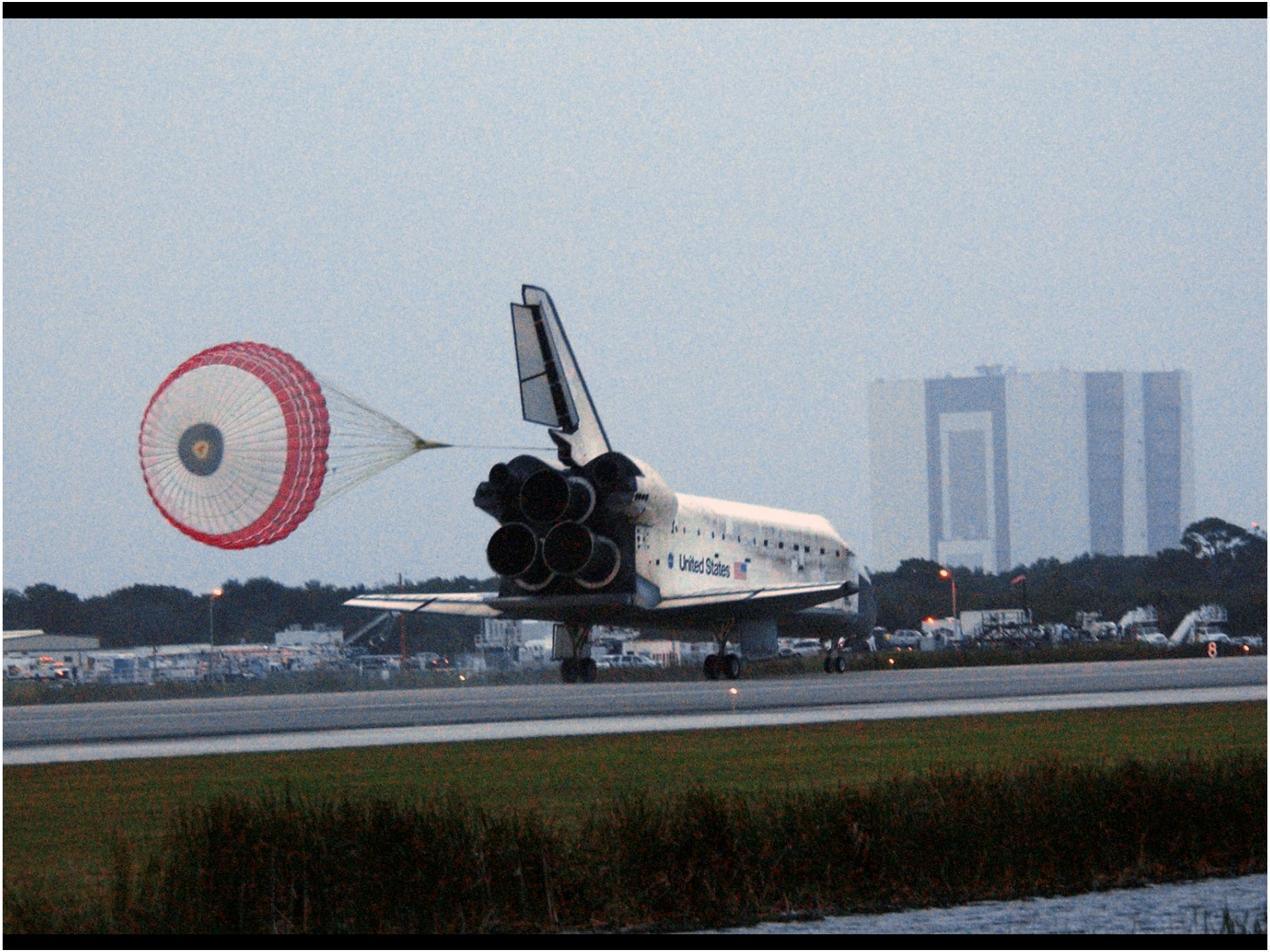



United States


3


4


United States
11


United States


CONVOY COMMAND VEHICLE
PAYLOADS
EXPERIMENTS


NASA
905

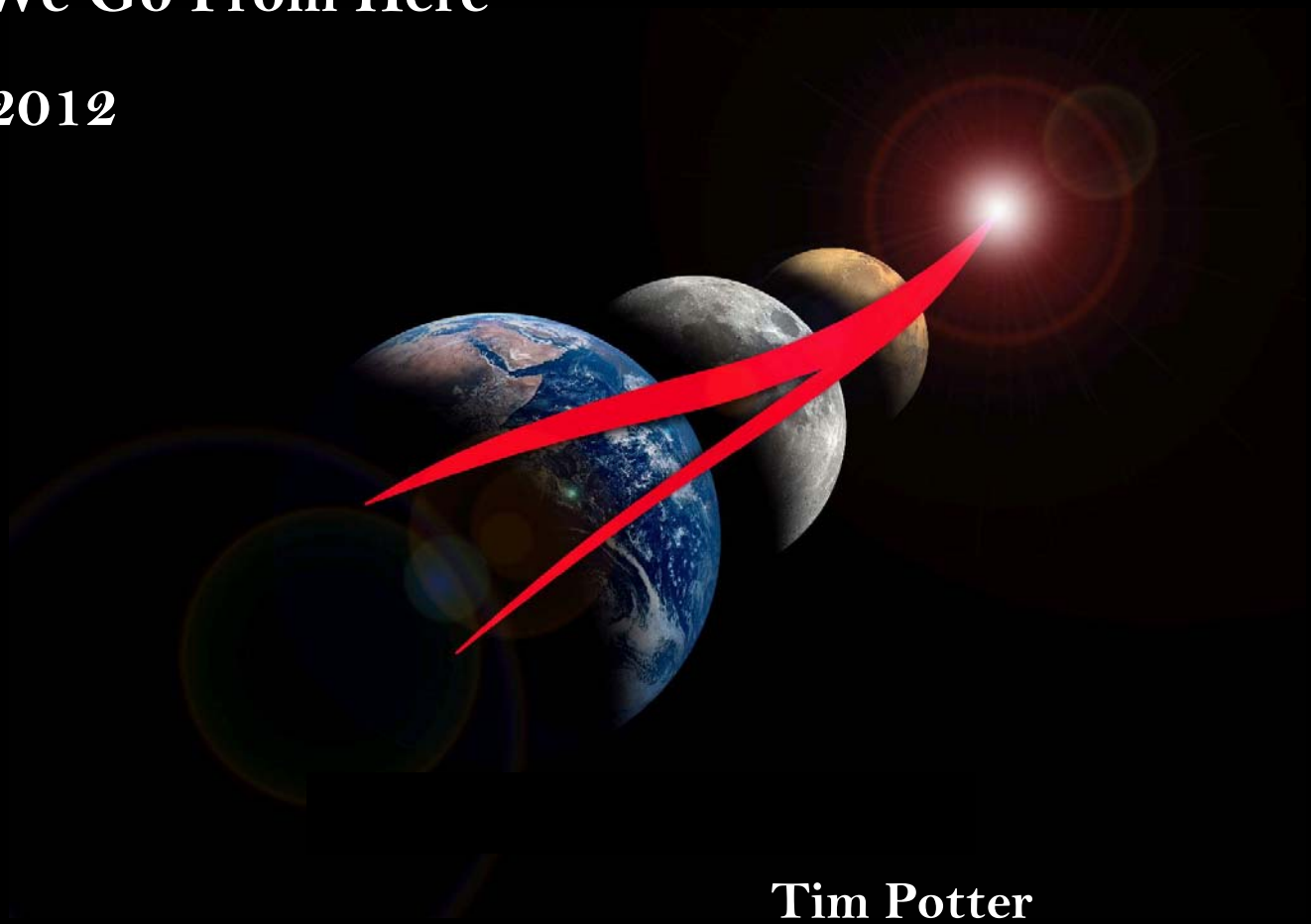

NASA
905

- Discovery (OV-103) is going to the Udvar –Hazy Center, Smithsonian's Air and Space Museum, Dulles, Virginia.
- Atlantis (OV-104) is going to the Kennedy Space Center Visitor's Center, Florida.
- Endeavour (OV-105) is going to the California Science Center, Las Angeles, California.

From The Earth, To The Moon, Mars, and Beyond

Where We Go From Here

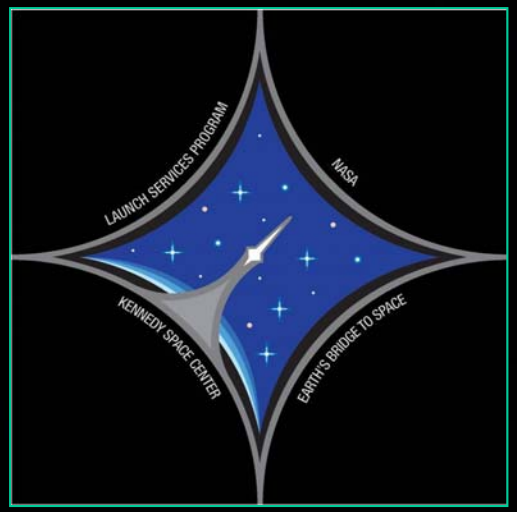
June 8, 2012



Tim Potter
NASA Test Director
Landing Recovery Director
Launch Complex Operations
Vehicle Processing Directorate

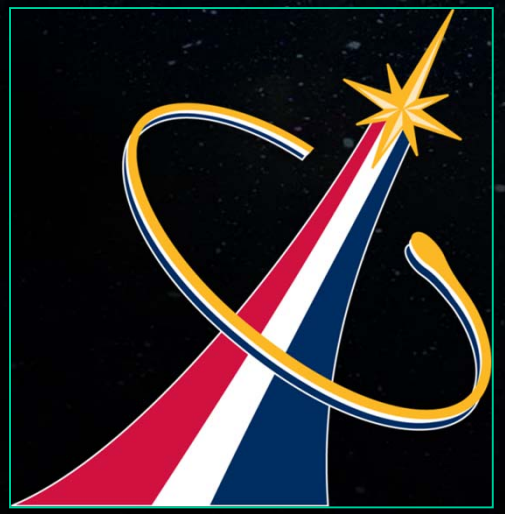
KSC Programs

NASA is embarking on a new era of encouraging commercial development of efficient and affordable launch capability to low earth orbit (LEO) for delivery of cargo and eventually crews. Meanwhile the agency is also pursuing the development of deep space human exploration capability.



Launch Services Program (LSP)

Ground Systems Development and Operations Program (GSDO)



Commercial Crew Program (CCP)

LAUNCH SERVICES PROGRAM (LSP)

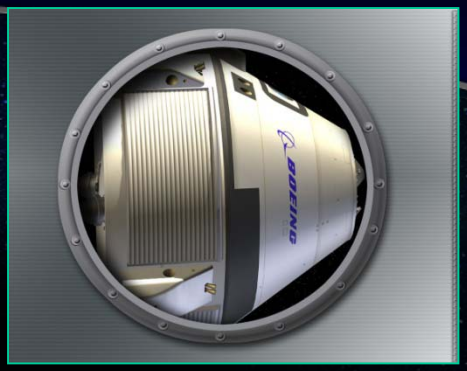
The LSP program has provided Delta IV and Atlas V medium to heavy lift capability since 1998. Some partners intend to use the Atlas V in a man-rated version for commercial crew.

Mars Science Laboratory (MSL)
Launched November 26, 2011
Arriving at Mars in August 2012

COMMERCIAL CREW PROGRAM (CCP)

ATK

Blue Origin



Boeing

Sierra Nevada

SpaceX

ULA

Excalibur Almaz

COMMERCIAL CREW PROGRAM (CCP)

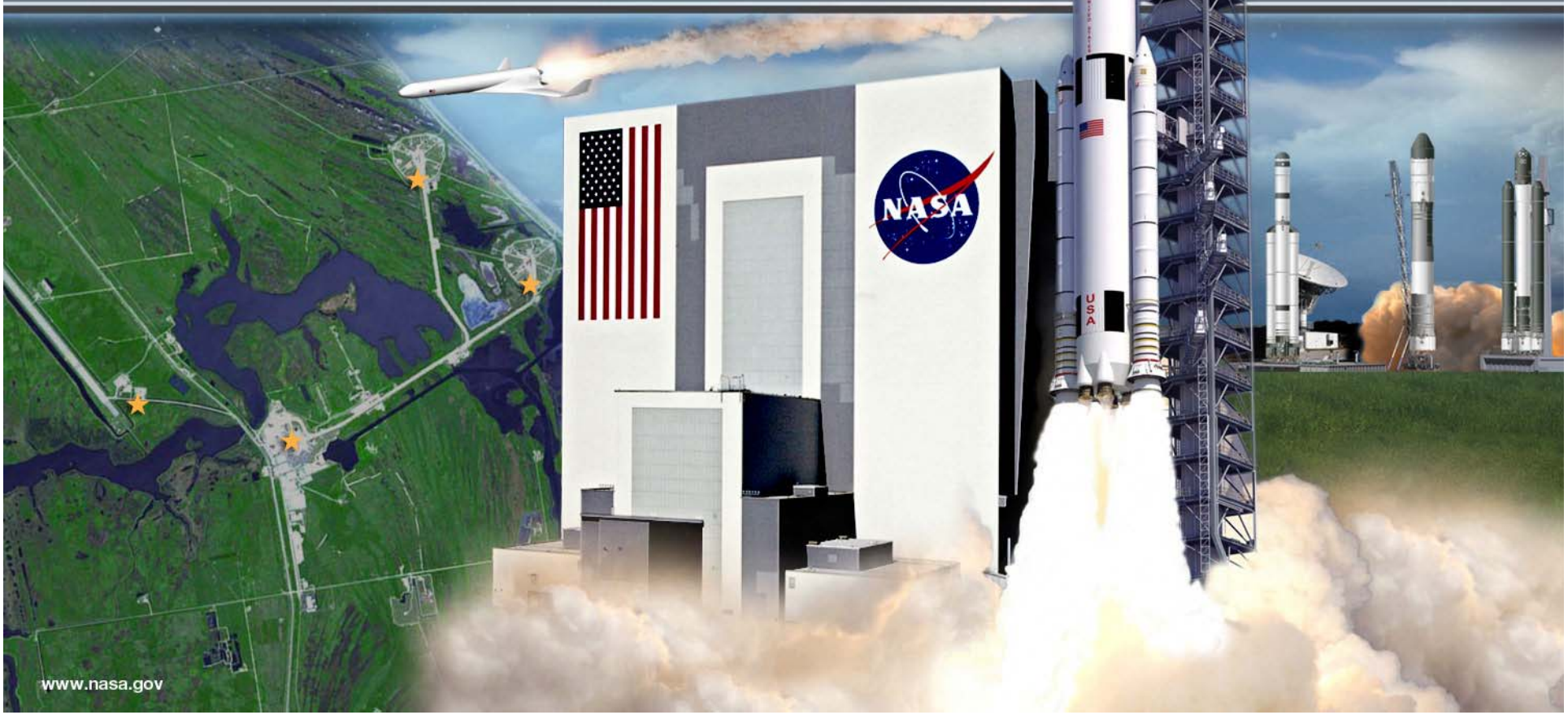
- There are currently 7 commercial partners developing launch capability for future LEO operations.
- Some plan to provide cargo only and some both cargo and crew.

Partner	Spacecraft	Launch Vehicle
ATK	TBD	Liberty
Blue Origin	Biconic	New Sheperd (VTVL)
Boeing	CST-100	Atlas V
Sierra Nevada	Dream Chaser	Atlas V
SpaceX *	Dragon	Falcon 9
ULA	CST-100/Dream Chaser	Atlas V
Excalibur Almaz	TBD	TBD

* SpaceX is planning their 2nd launch of the Falcon 9 with the Dragon capsule for a rendezvous and docking to the ISS on April 30.

National Aeronautics and Space Administration

GROUND SYSTEMS
Development and Operations



www.nasa.gov

GROUND SYSTEMS DEVELOPMENT AND OPERATIONS PROGRAM (GSDO)

- The GSDO mission is to transform the infrastructure at the Kennedy Space Center into a 21st Century launch complex to support both NASA and commercial processing, integration, test, and launch capabilities.

- NASA's next major effort in the future of human space exploration is the Space Launch System (SLS) and the Multi-Purpose Crew Vehicle (MPCV)

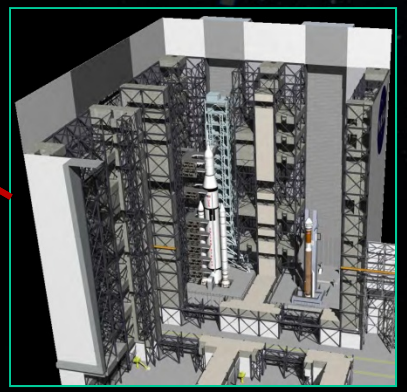
GROUND SYSTEMS DEVELOPMENT AND OPERATIONS PROGRAM (GSDO)

Flexible Launch Capability

Shuttle pad configuration

OPF-3 Engine Shop

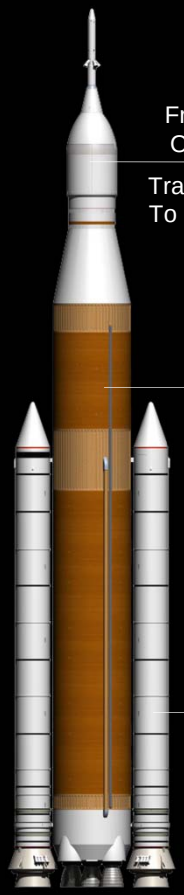
OPF-3



Multi-use Integration (VAB)

GROUND SYSTEMS
Development and Operations

NASA



From O&C

Transport To MPPF

Offline Spacecraft Processing

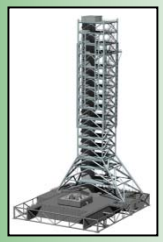
MPPF

Transport to VAB

CCC & Range

Vehicle Integration and Launch

Vehicle Integration & Test



Transport to pad

Launch Pad 39 B

Lift-Off

No SRB Recovery

Receive at Barge Terminal

Transport Elements to VAB

Offline SRB Processing

Transport to RPSF

Transport to ARF

Transport Aft Skirt to RPSF

Landing & Recovery

CM Landing

CM & Crew Recovery

West-coast de-servicing & Transport to KSC

SLS / MPCV CONCEPT OF OPERATIONS

SPACE LAUNCH SYSTEM (SLS)

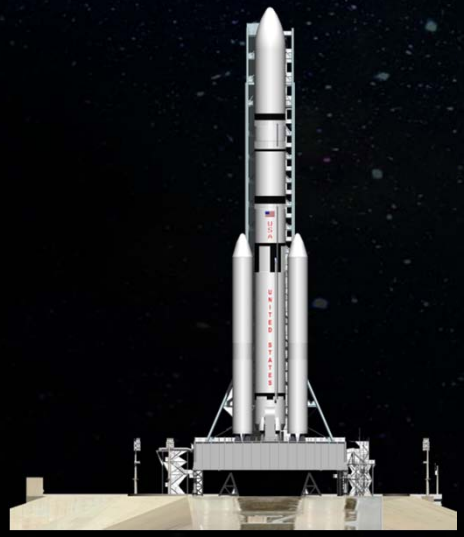
Space Shuttle

STS
LEO 24t
53,000 lbs.
3 SSME's

Initial Design

Block 1 / 1A LEO
70t -105t
154,000 – 232,000 lbs.
4-5 SSME's
J2X Upper Stage

Evolved Design



Block 2 LEO 130t
286,600 lbs.
5 SSME's
J2X Upper Stage

SPACE LAUNCH SYSTEM (SLS)

Accomplishments To Date

- SLS just completed its combined systems requirements and system definition review
  - Set requirements to further narrow the scope of the system design.
  - Evaluate the vehicle concept based on top-level program requirements.
  - Set launch vehicle requirements for crew safety.
  - Set requirements for ground operations and launch facilities at KSC.
  - Set cost and schedule requirements to provide on-time development.
  - This review moves the SLS from concept development to the preliminary design phase .

- The J2X upper stage engine testing at Stennis Space Center just completed its turbo machinery testing for the upper half of the engine.

- ATK testing for the 5 segment SRB is on-going.

- Morpheus with its Autonomous Landing and Hazard Avoidance Technology (ALHAT) will be testing at KSC this summer.

WHERE WE GO FROM HERE

Accomplishments To Date

- The Infrastructure at KSC is gradually changing:
  - Pad B has already been demolished from the Shuttle configuration and is undergoing upgrades to connect it with firing room 1.
    - Pad B subsystems, Ground Special Power, ECS, Ignition Overpressure Sound Suppression (IOP/SS), KSC Ground Control System (KGCS), new weather and lightning detection system are installed and ready for verification testing.
  - Firing Room 1 Spaceport C&C System (SCCS) hardware is installed; software is being installed. The comm system will follow.
  - Pad A has been transferred to LX and is going through a decision process for potential multi-user capability.
  - OPF-3 is already transferred to Space Florida and Boeing for CTS-100 processing.
  - OPF's 1 and 2 will go through similar changes once the Orbiters are transported.
  - The ML built for Constellation will be transformed to accept SLS.
  - The VAB has been transferred to LX and plans are in work for transforming Hi-Bay 3 for SLS. Other VAB work is on-going to enable multi-user capability for future efforts.
  - The O&C has already been transformed to start the construction , processing, and test of the MPCV.
  - New organizations have been started and renovated office space have been built to support all these future efforts.

WHERE WE GO FROM HERE

Technology Development Required for the Future

- Propulsion
  - Chemical Propulsion advancement
  - Ion Electric - Variable Specific Impulse Magnetoplasma Rocket (VASIMR)
  - Solar Electric
  - Nuclear Electric Propulsion (NEP)
  - Nuclear Thermal Propulsion (NTP)
  - FTL Propulsion – Faster Than Light
- Cryogenic Propellant Production, transportation, and zero boil-off storage and distribution systems.
- Starship Development - We aren't sending humans to Mars in a capsule.
- In-Situ Resource Utilization Development
  - Radiation Shielding
  - Food Production
  - Power Production
  - Air Supplies
  - Water Supplies
  - Fuel Supplies
  - Human Habitation, both deep space and surface.

- Deep Space Communication Systems
- Human-Robotic interfaces.

- Whatever the hell else I forgot???? Bottom line is: There is a lot of work to do!!!


"We leave as we came, and God willing, as we shall return,
with peace and hope for all mankind."
— Eugene Cernan, Commander of
the last Apollo mission
The journey continues.
We invite you to join us as we write the next
chapter in the human exploration of space.