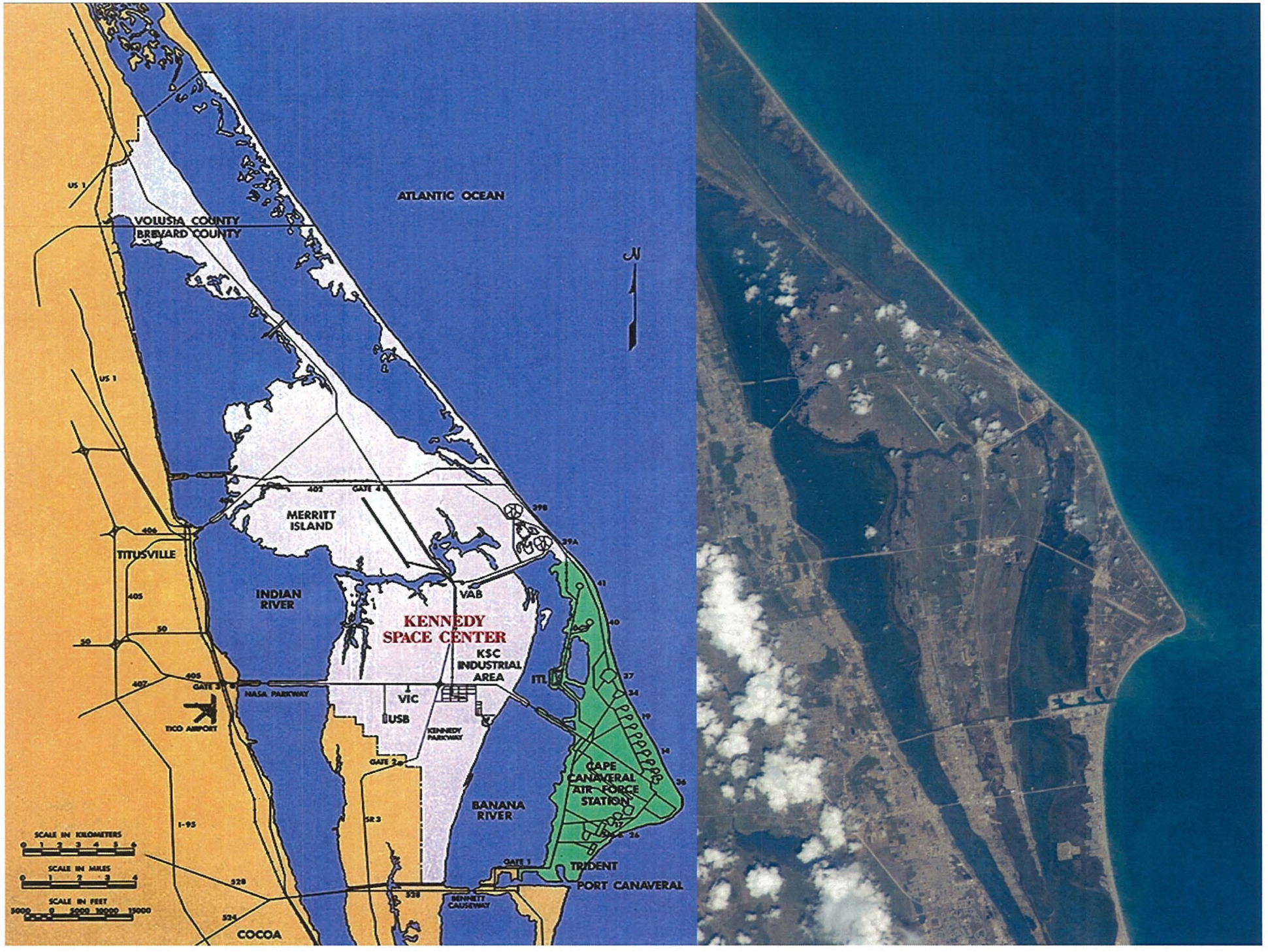
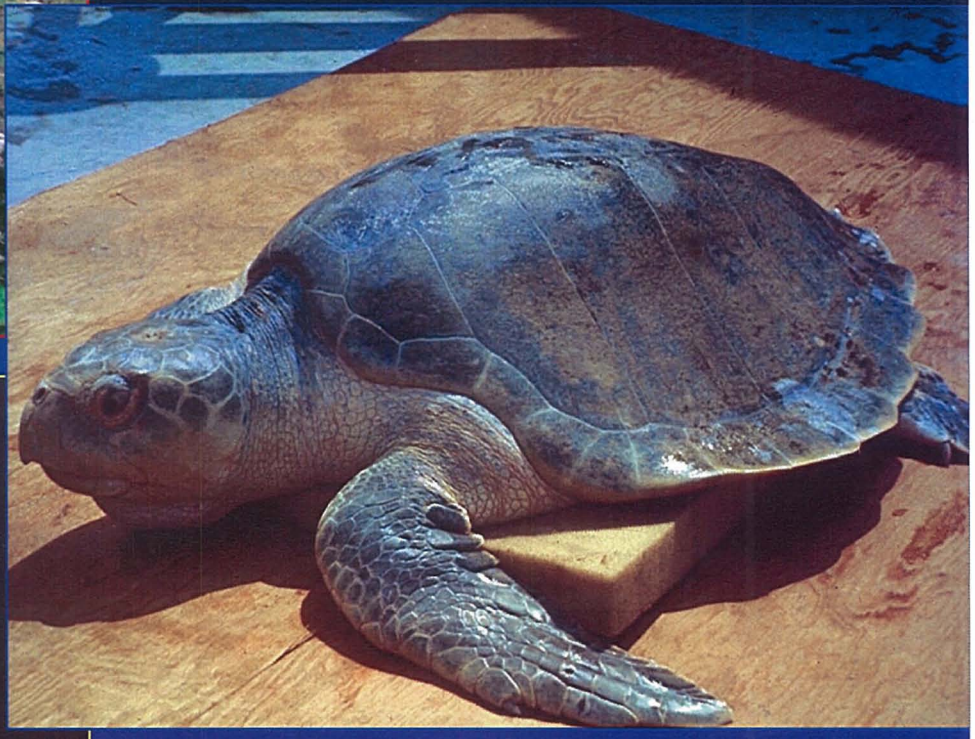
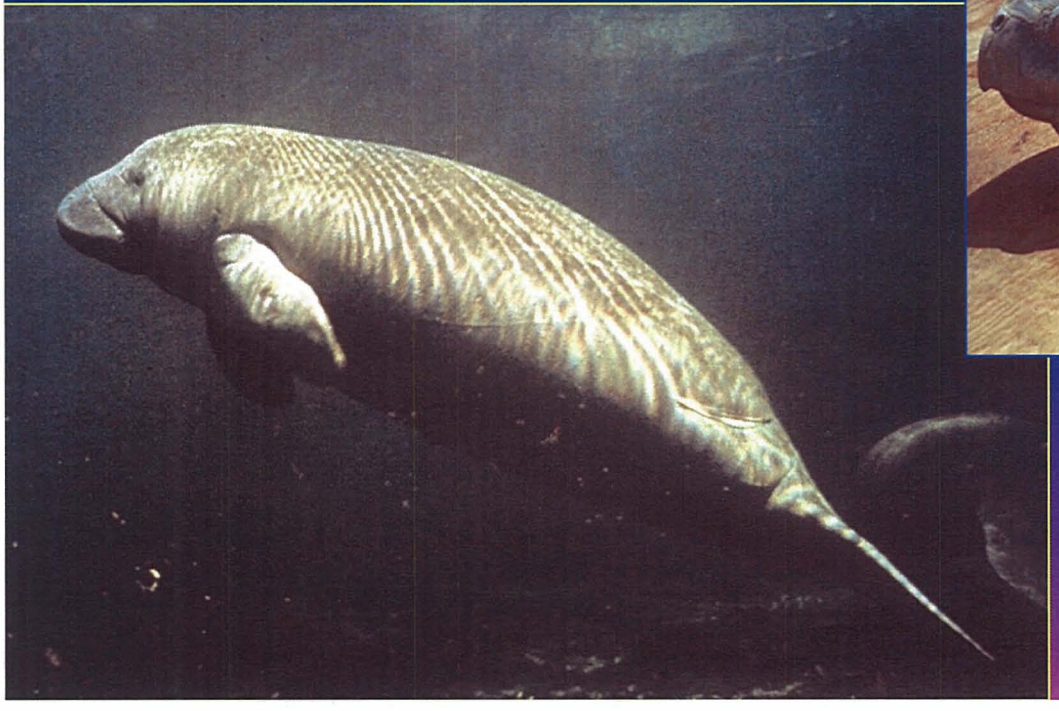
Kennedy Space Center, Space Shuttle Processing, and International Space Station Program Overview

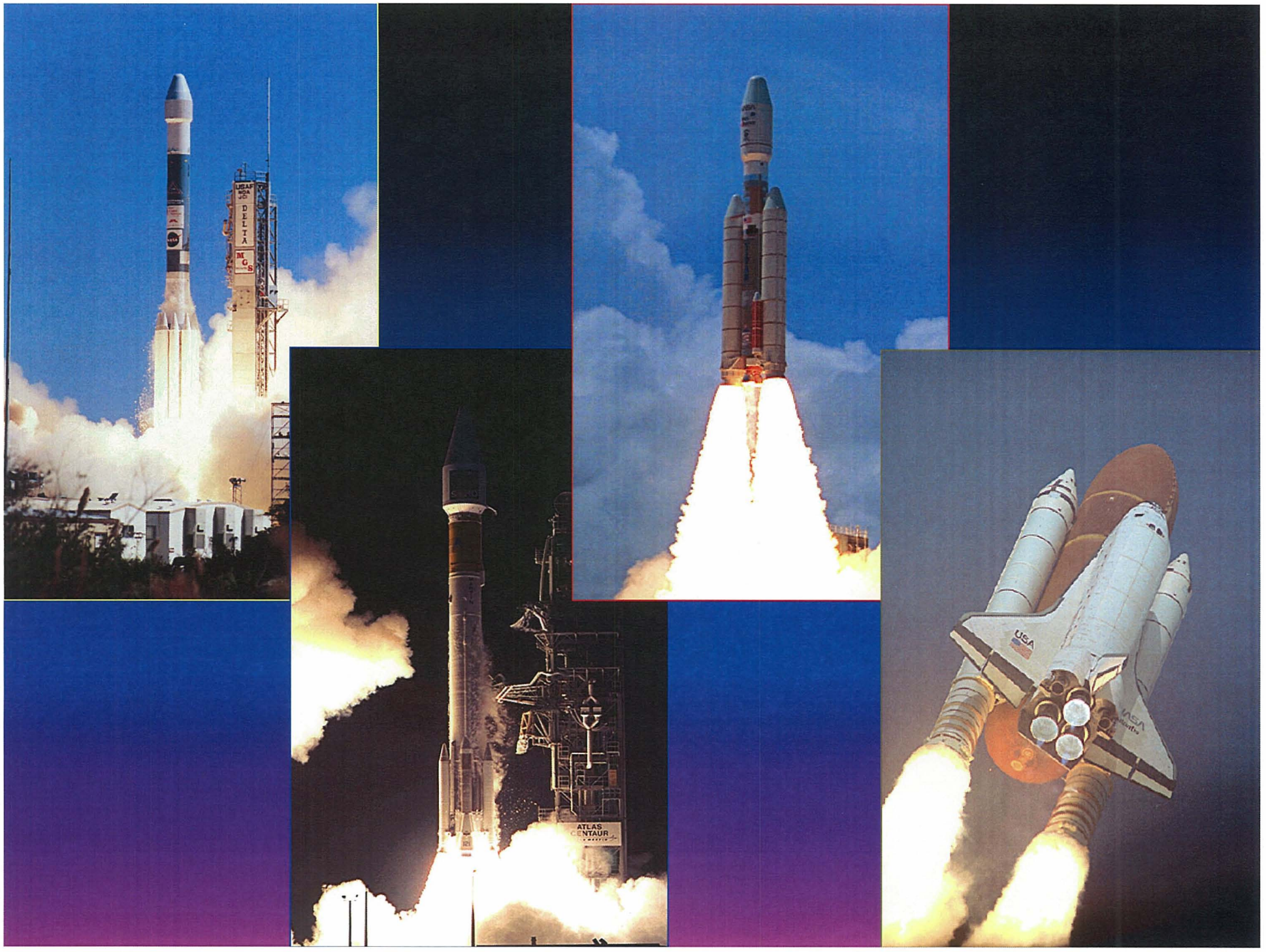
Scott Higginbotham

Mission Manager
International Space Station and Spacecraft Processing Directorate
NASA – John F. Kennedy Space Center


ATLANTIC OCEAN
VOLUSIA COUNTY
BREVARD COUNTY
US 1
MERRITT ISLAND
TITUSVILLE
INDIAN RIVER
KENNEDY SPACE CENTER
KSC INDUSTRIAL AREA
VAB
VIC
USB
ITL
NASA PARKWAY
KENNEDY PARKWAY
TICO AIRPORT
GATE 2
GATE 3
GATE 4
CAPE CANAVERAL AIR FORCE STATION
BANANA RIVER
TRIDENT
PORT CANAVERAL
BENNETT CAUSEWAY
COCOA
I-95
SR3
SCALE IN KILOMETERS
SCALE IN MILES
SCALE IN FEET

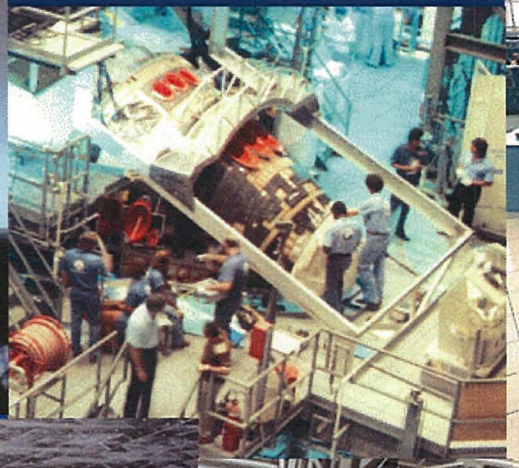





USAF
NASA
JPL
DELTA
MCS
ATLAS
CENTAUR
USA
NASA

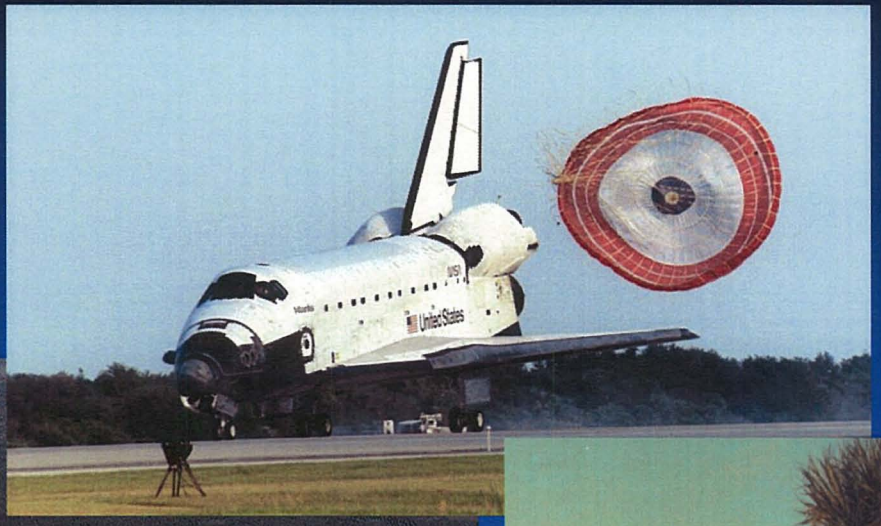
SPACE SHUTTLE GROUND OPERATIONS

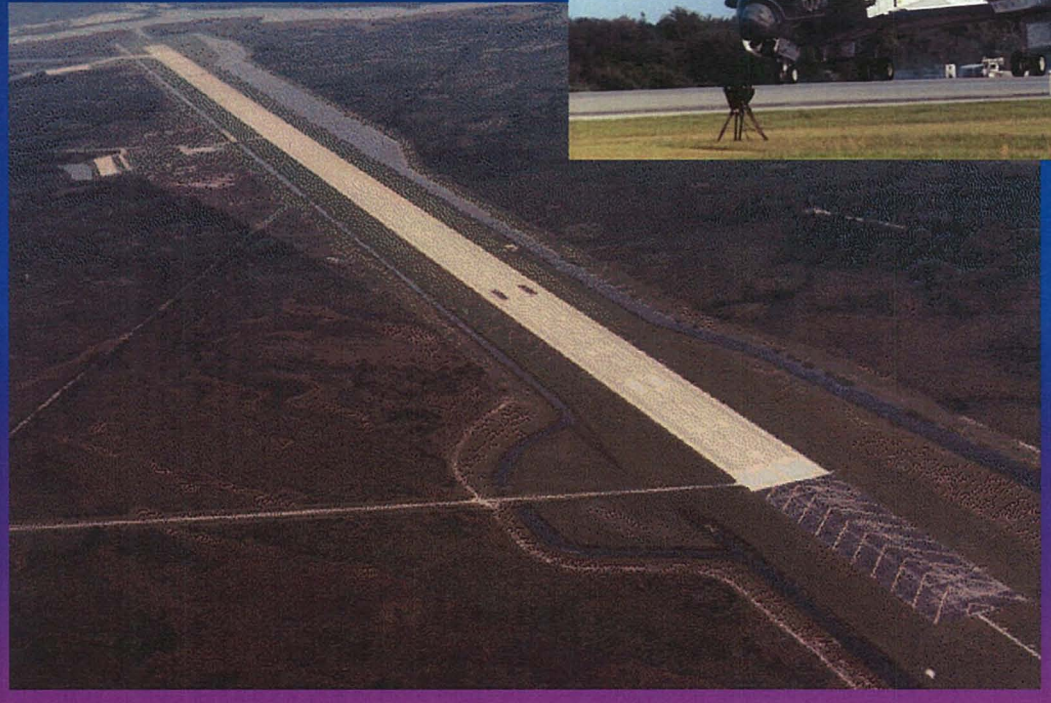
Shuttle Processing



SPACE SHUTTLE GROUND OPERATIONS

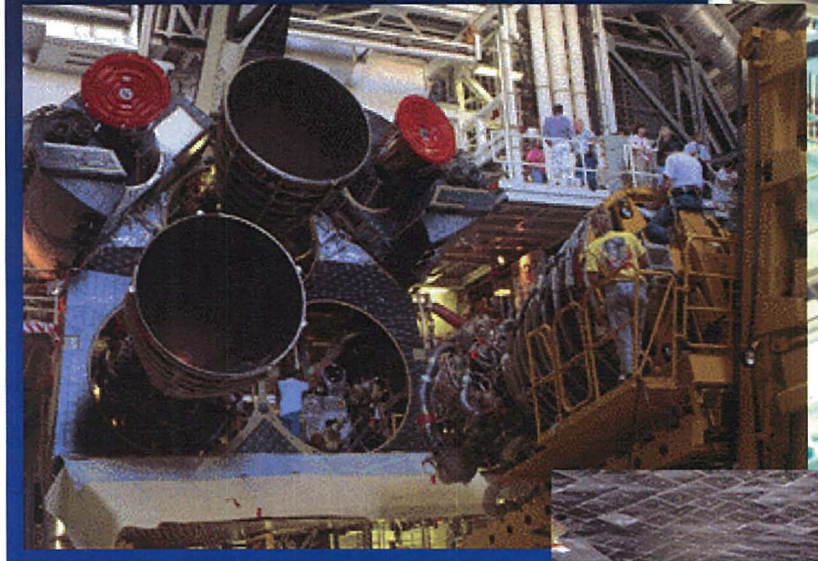
Shuttle Landing Facility (SLF)

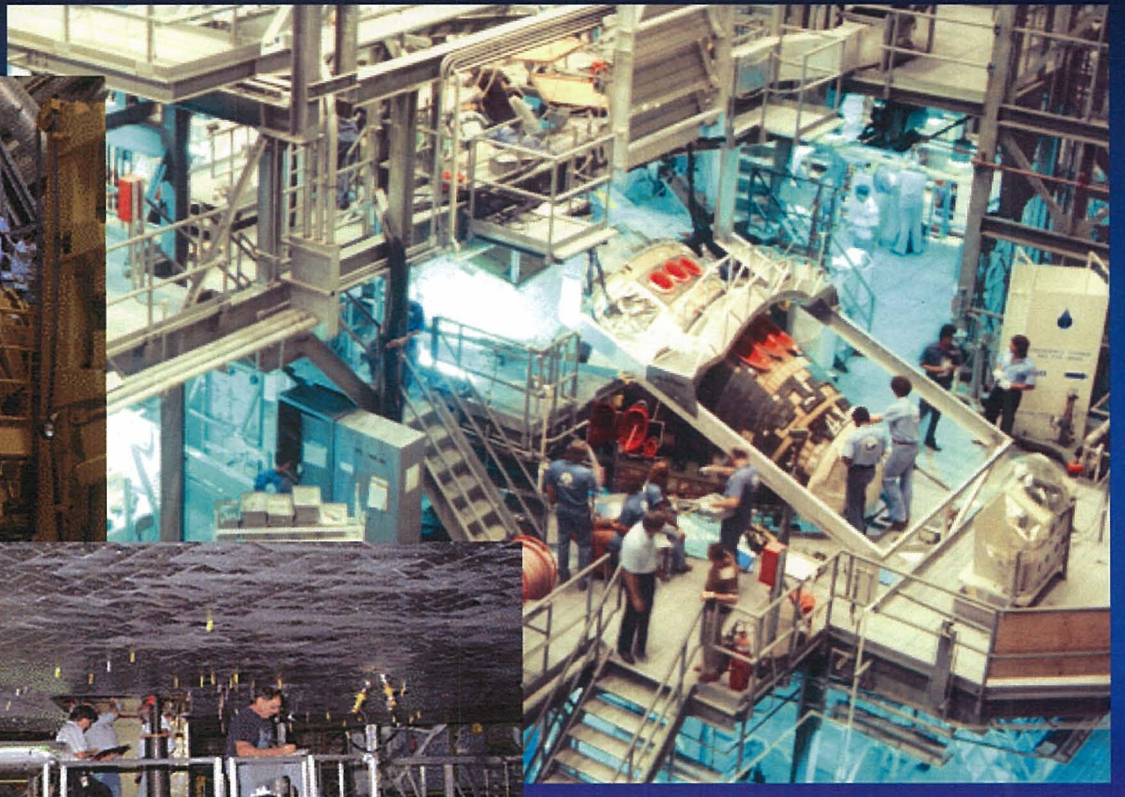




SPACE SHUTTLE GROUND OPERATIONS

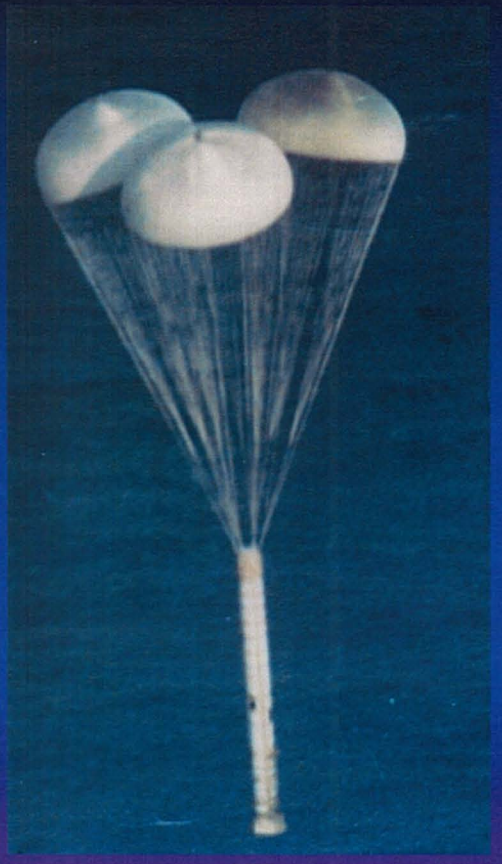
OPF Operations





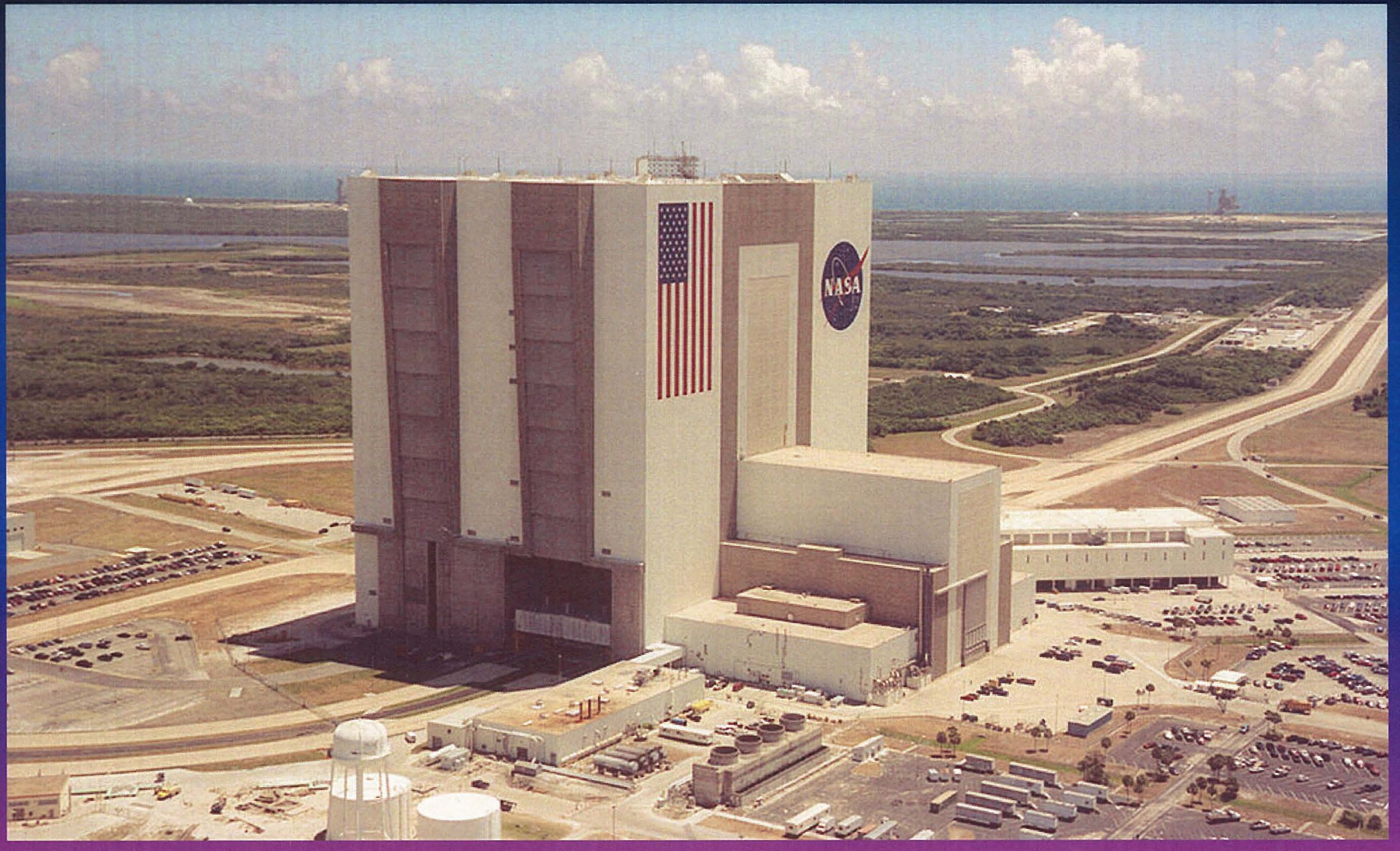
SPACE SHUTTLE GROUND OPERATIONS

SRB Recovery and Refurbishment

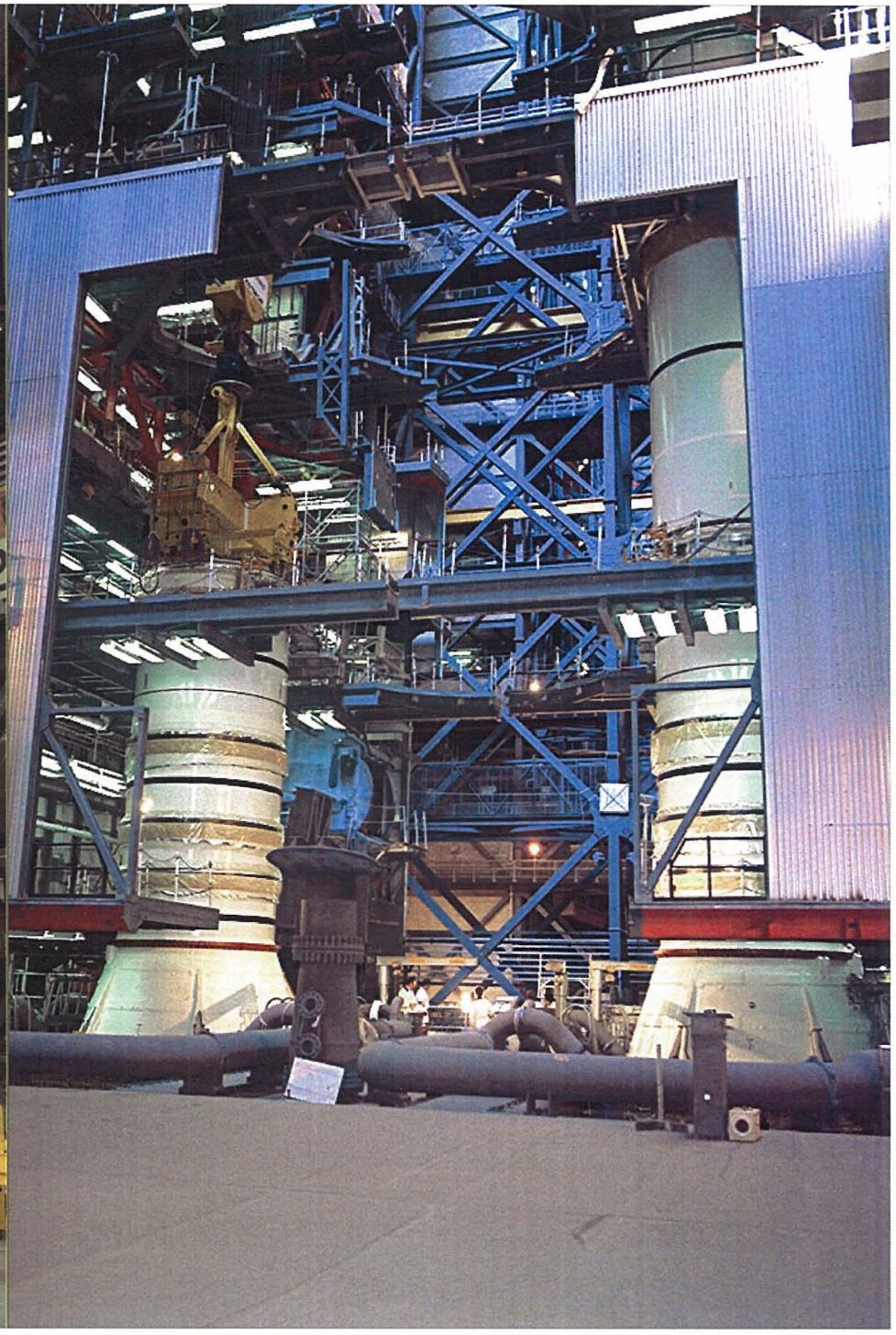


SPACE SHUTTLE GROUND OPERATIONS

VAB Operations

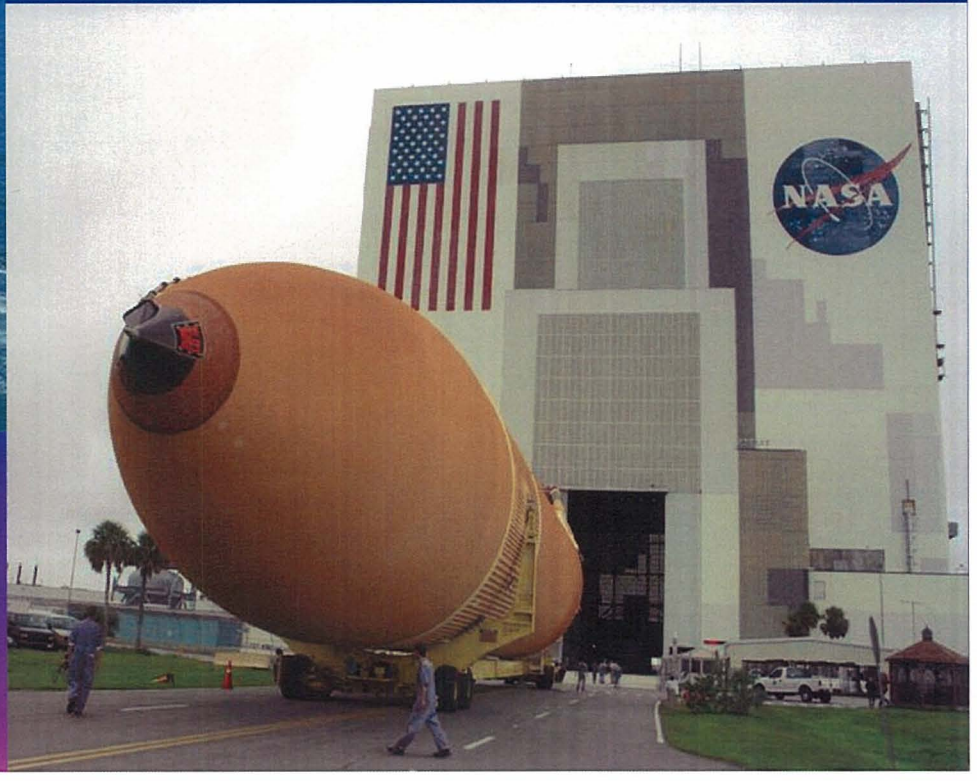


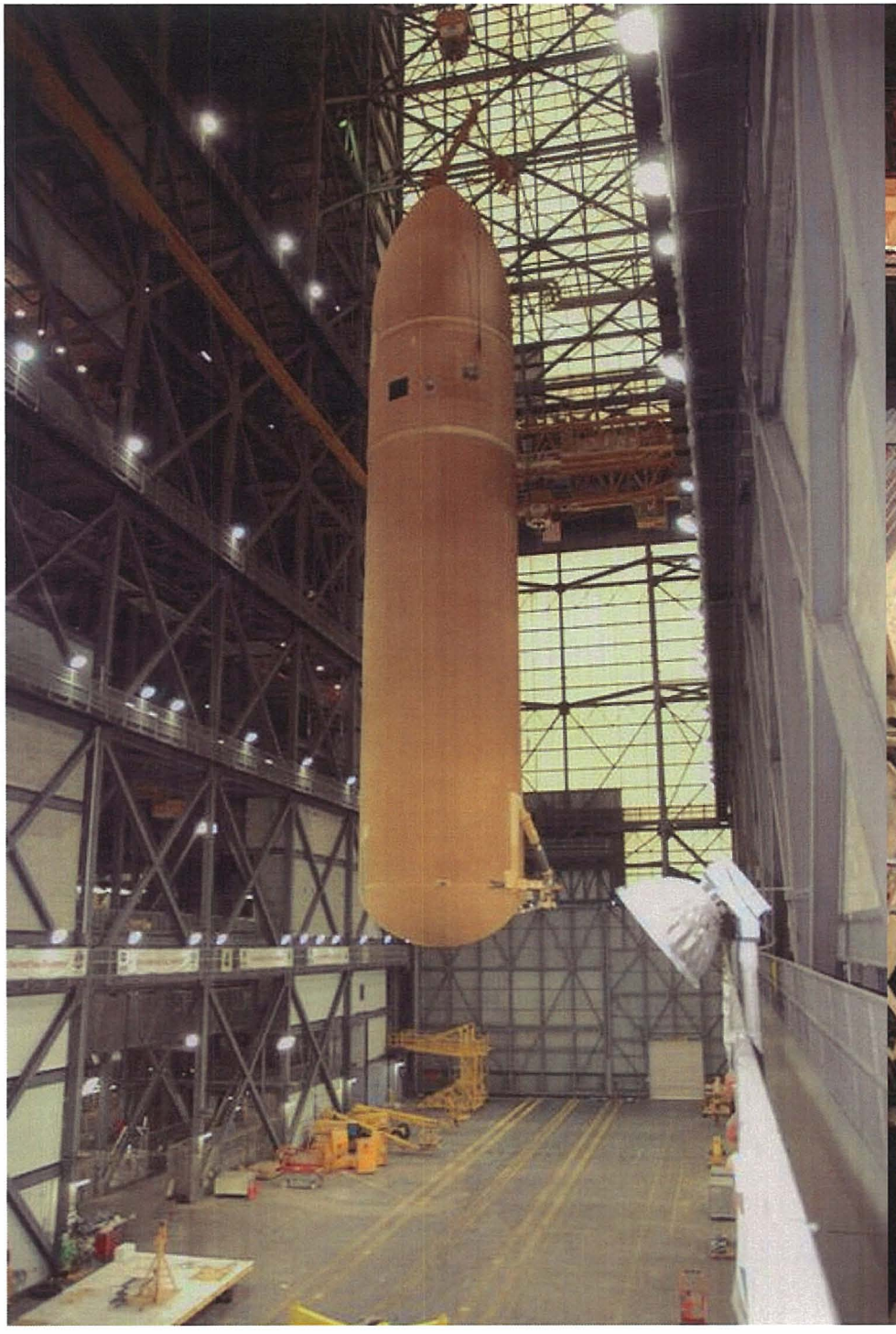

Endeavour

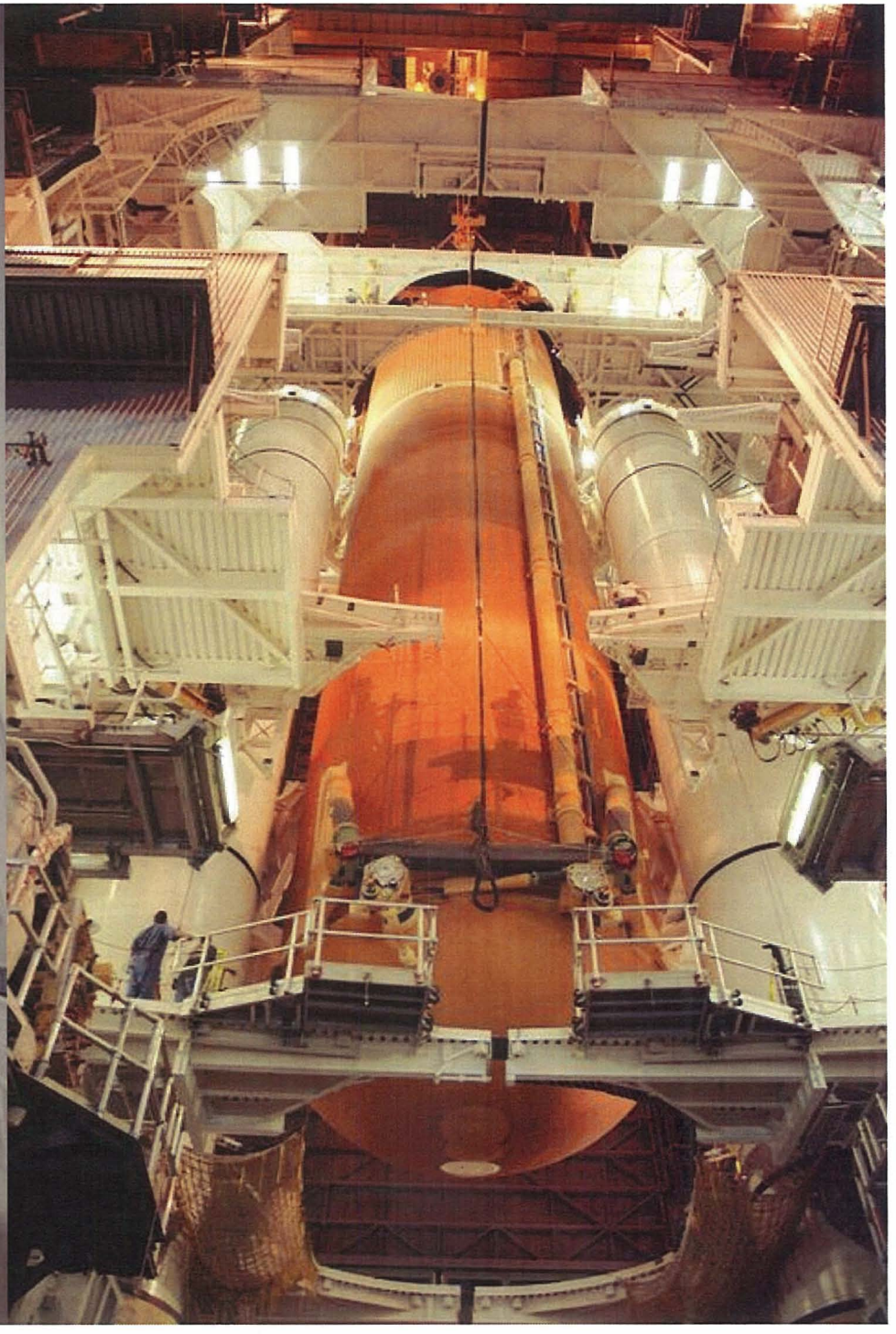


SPACE SHUTTLE GROUND OPERATIONS

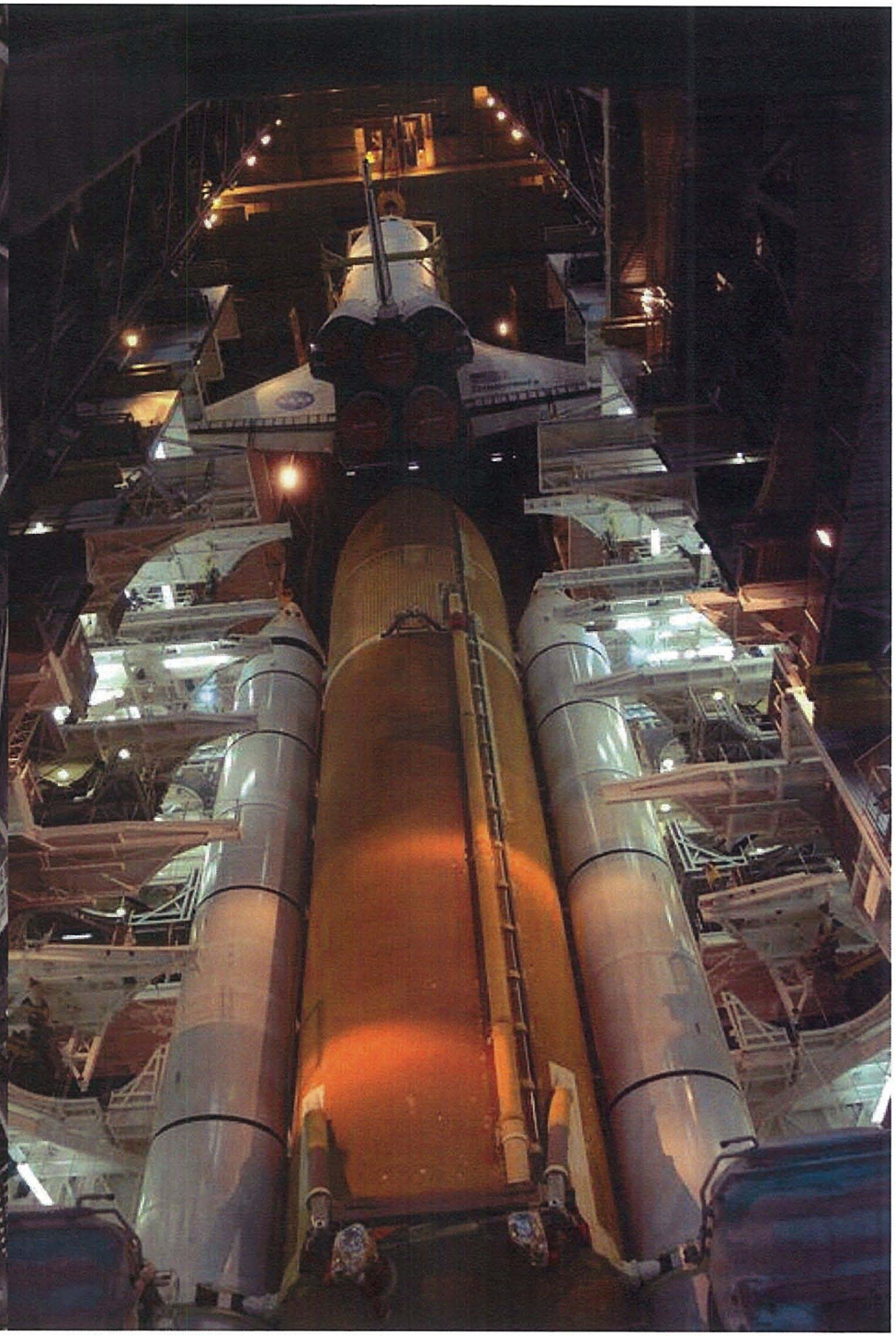
External Tank





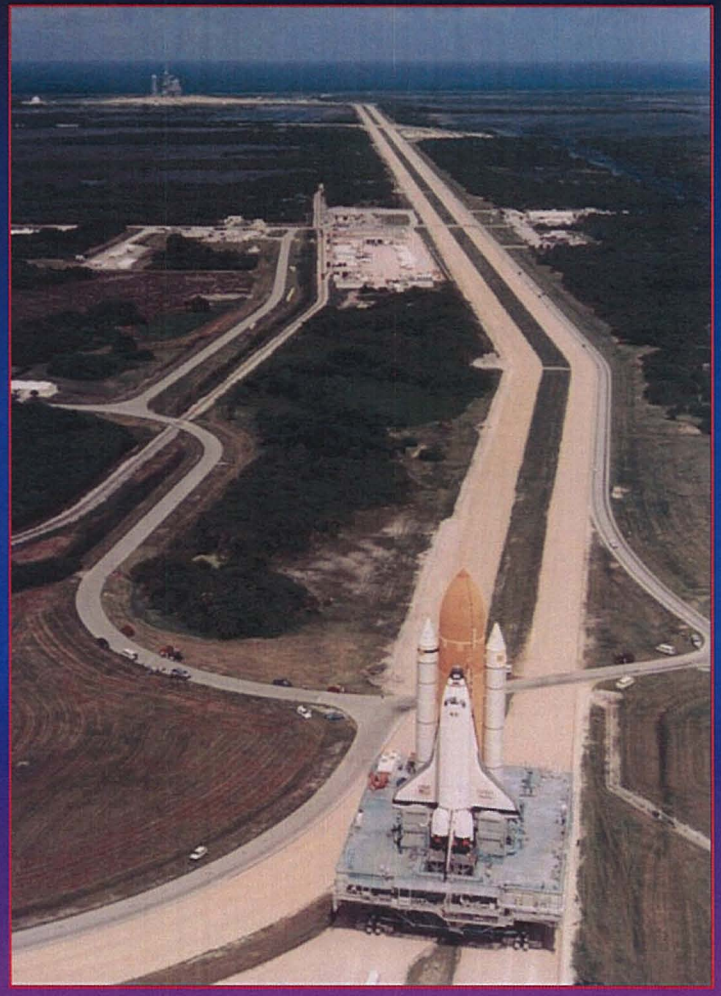


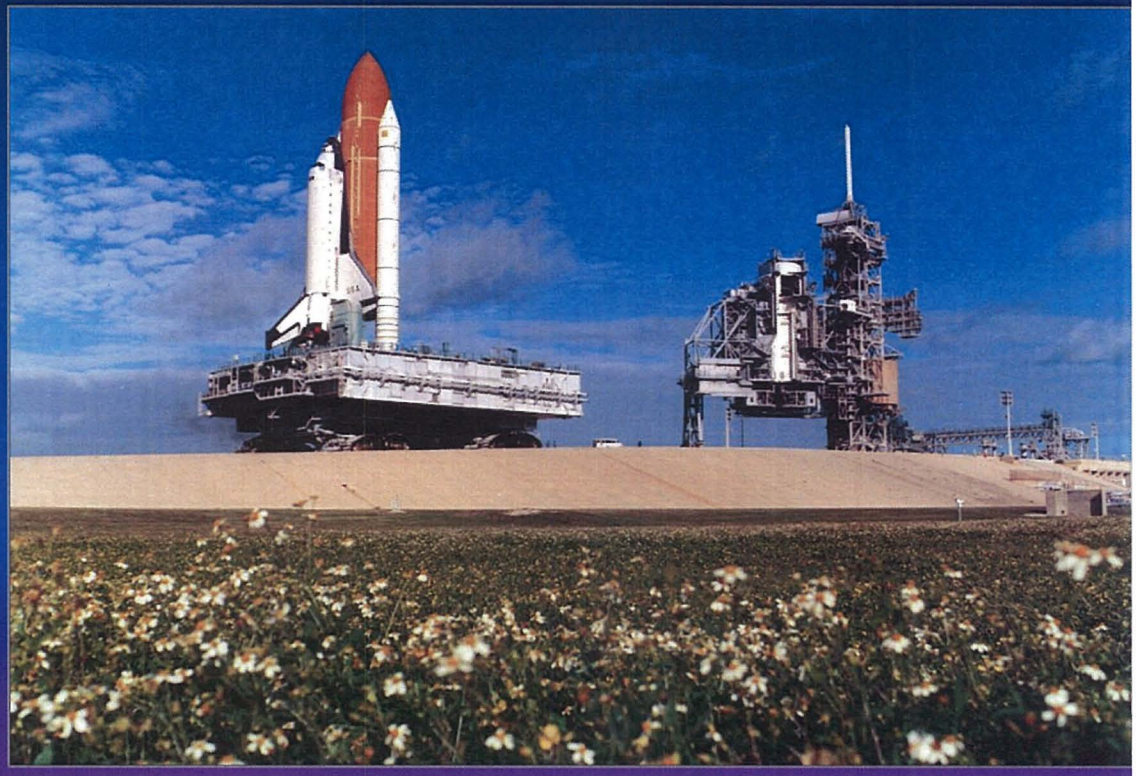

United States



SPACE SHUTTLE GROUND OPERATIONS

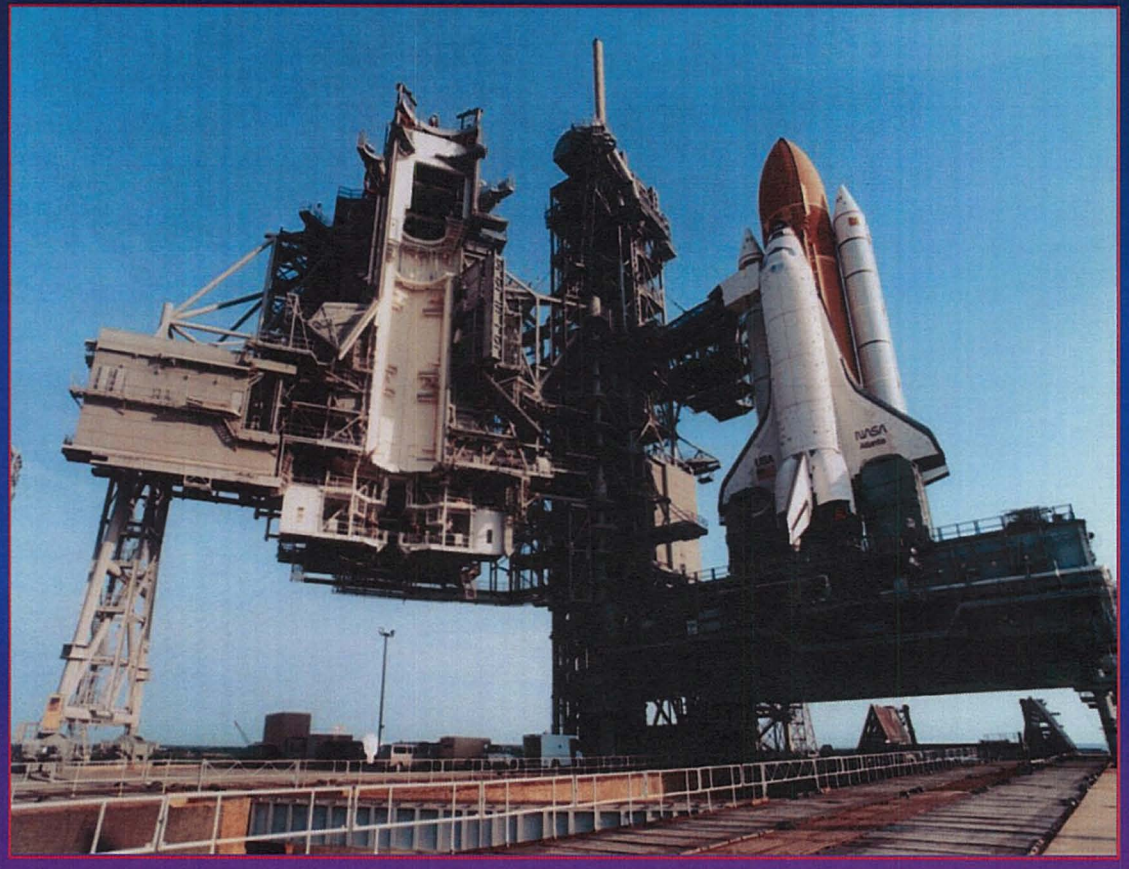
Rollout to Pad

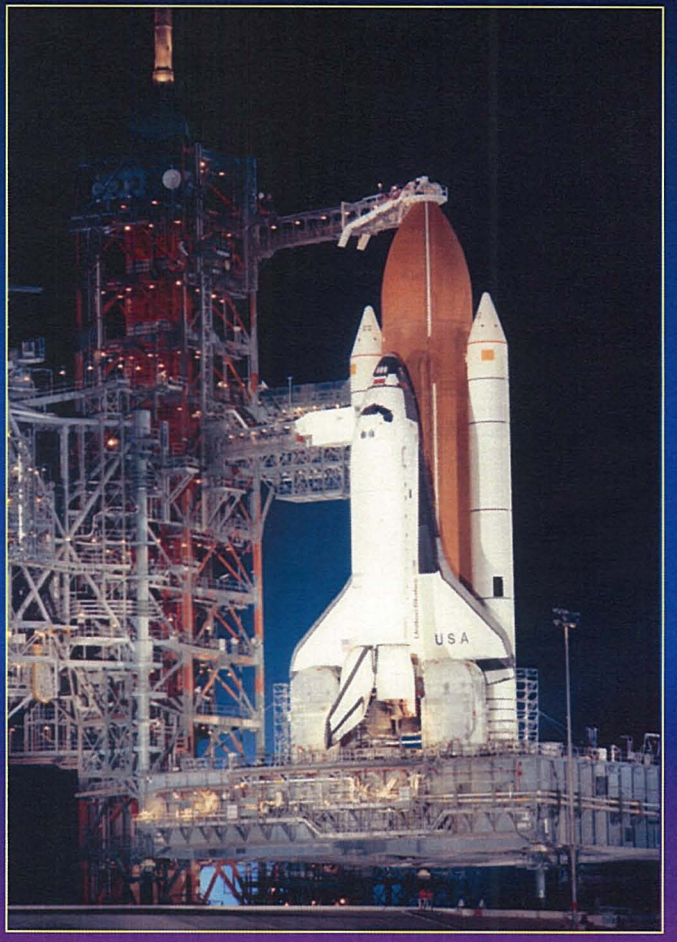


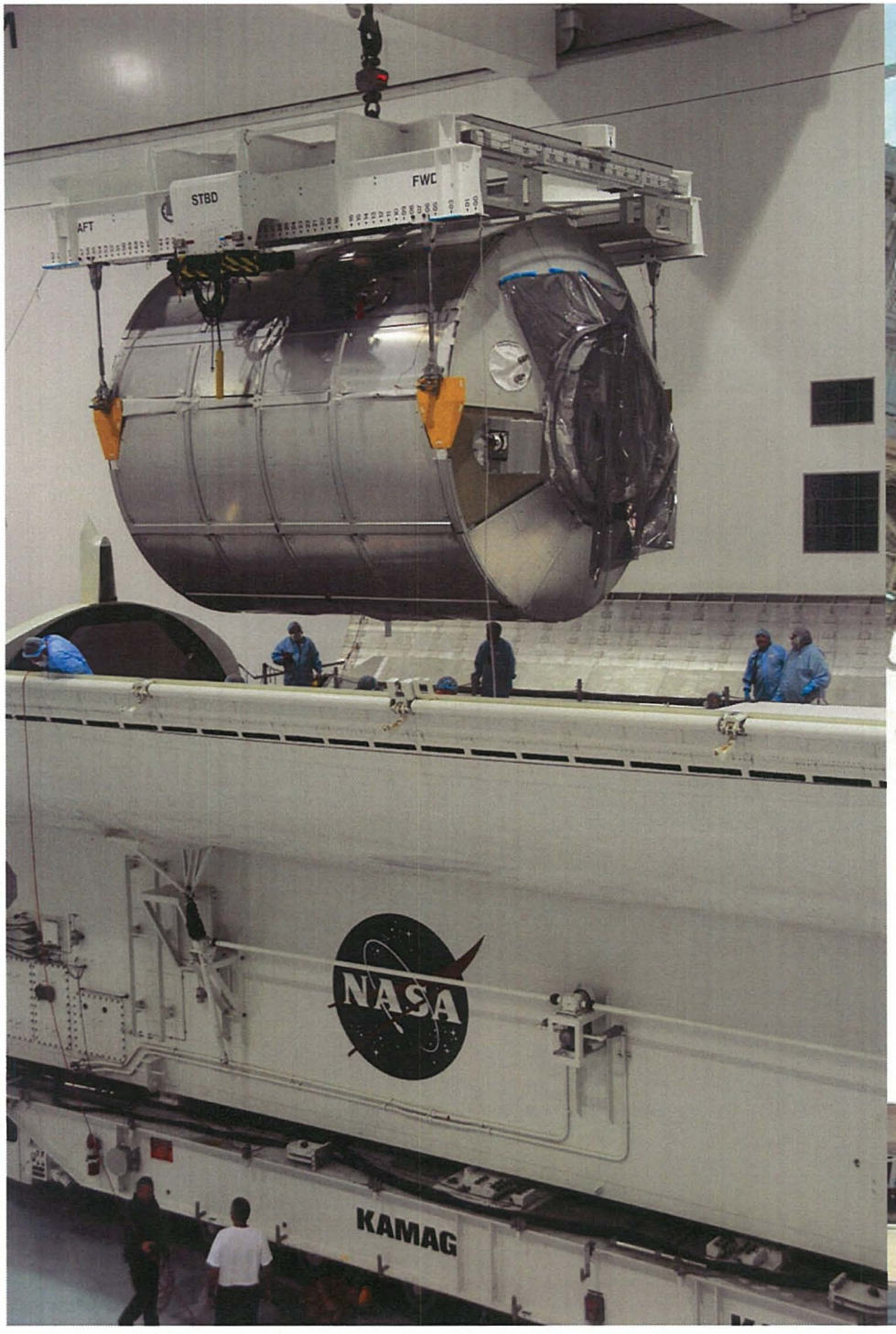


SPACE SHUTTLE GROUND OPERATIONS

Launch Pad



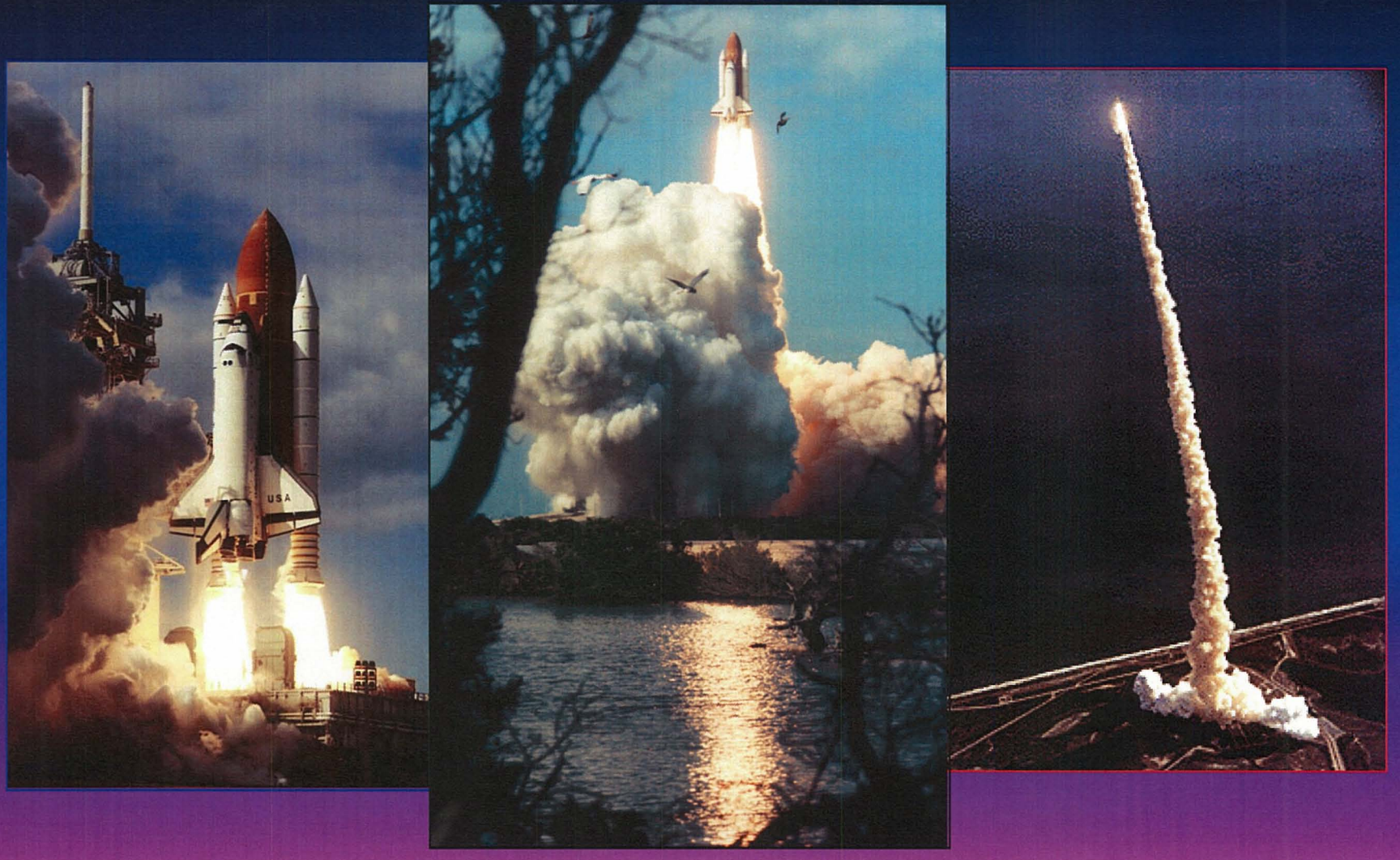


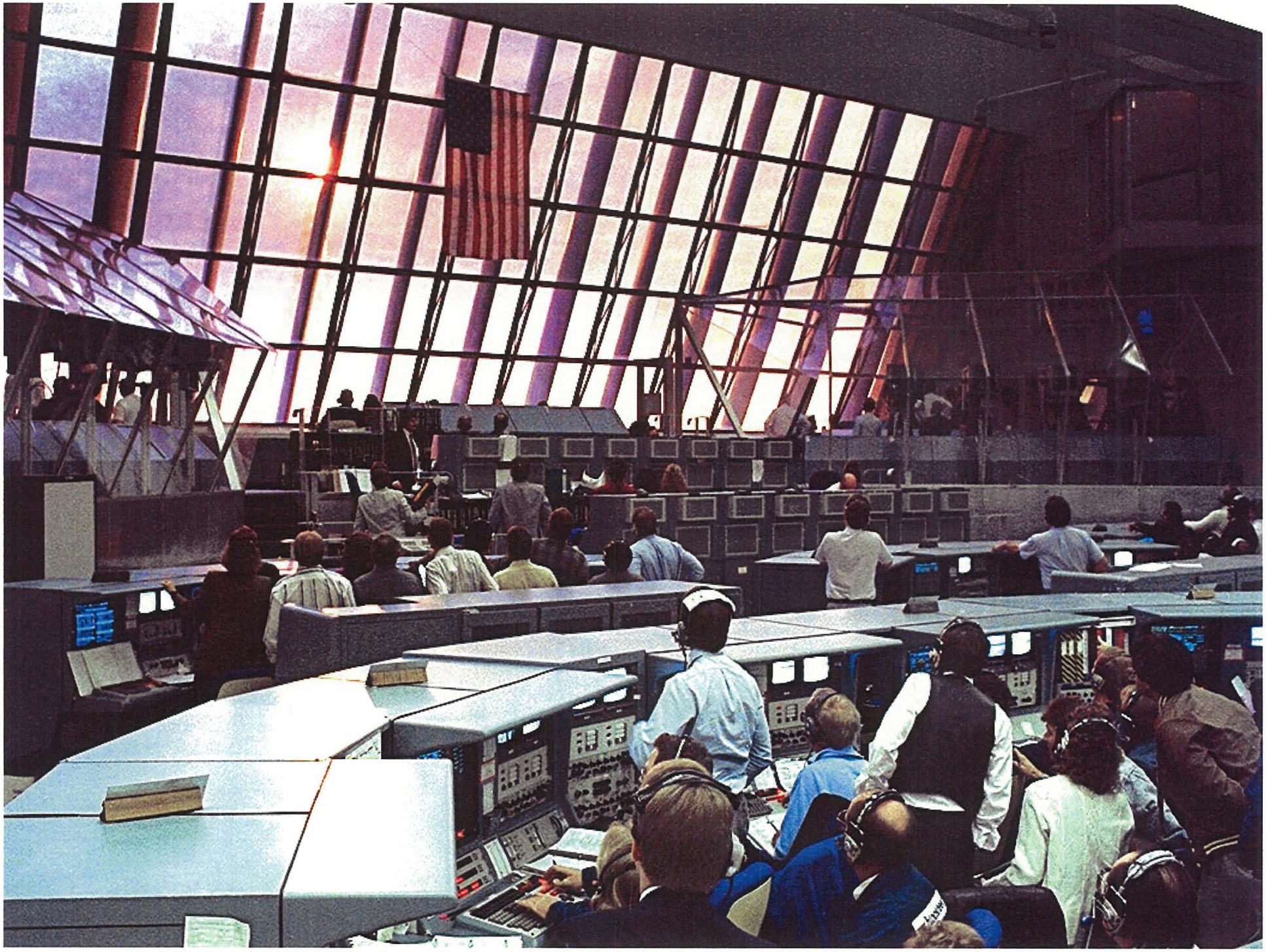

STBD
FWD
AFT
NASA
KAMAG

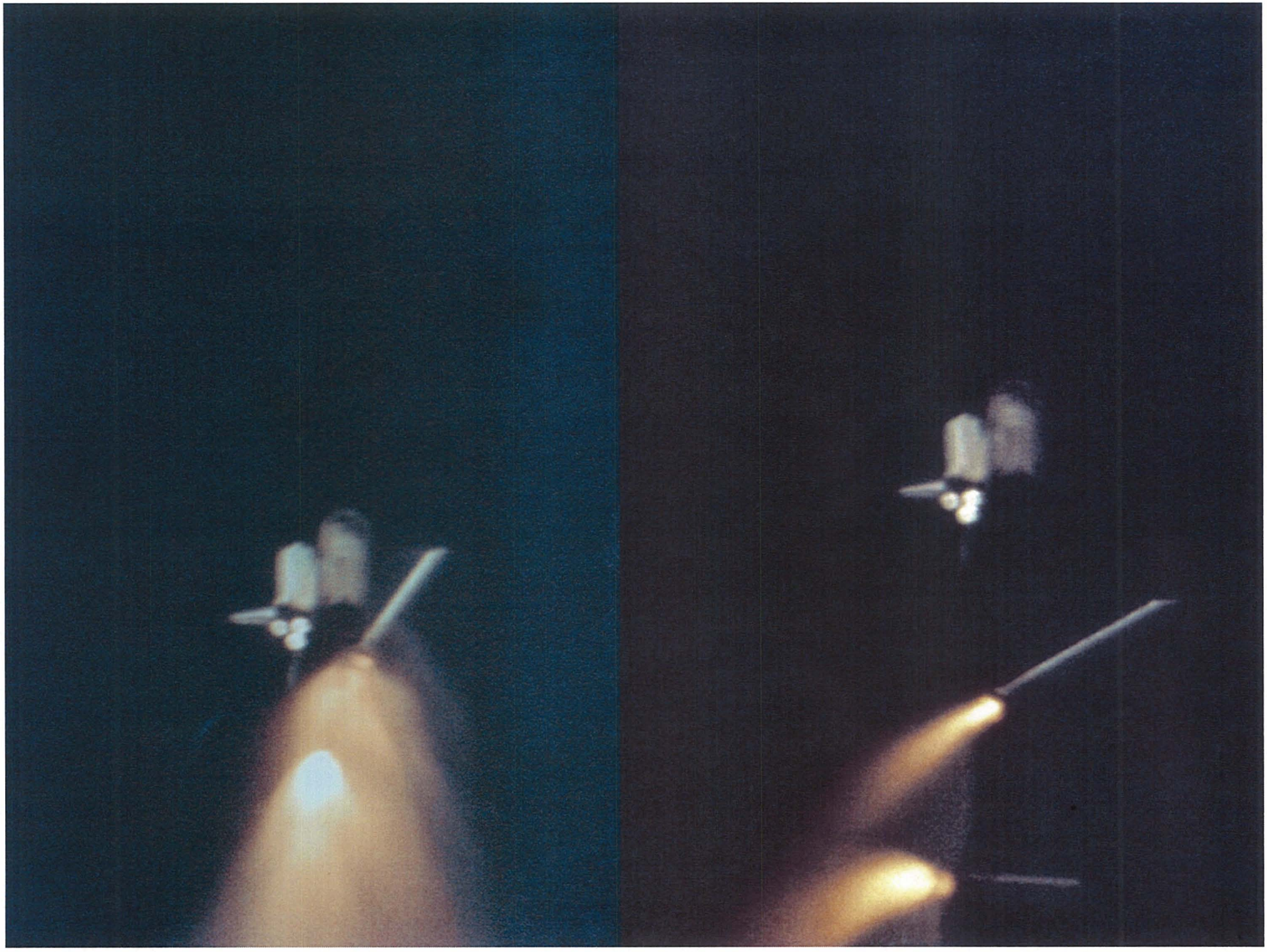

KAMAG

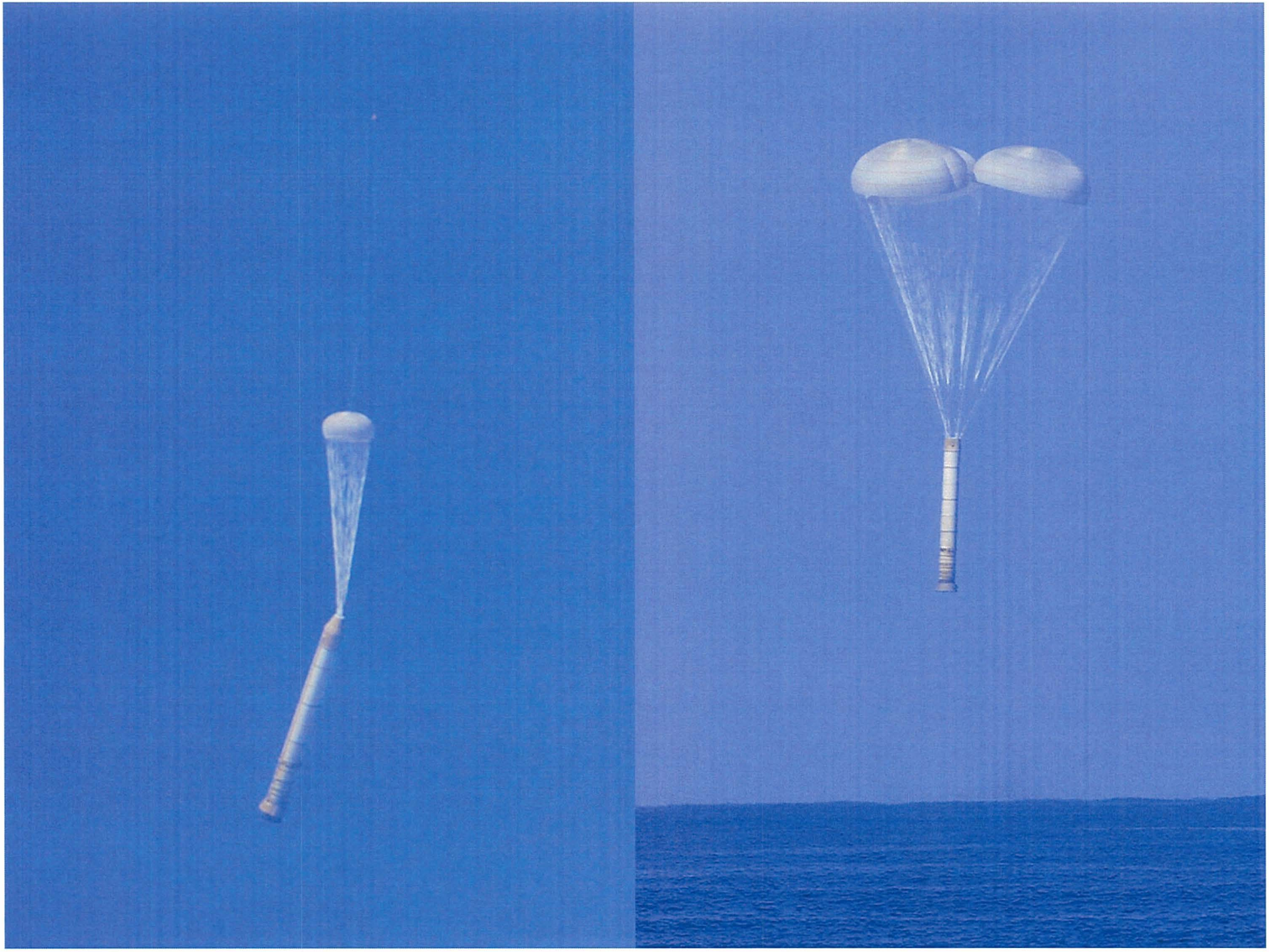
SPACE SHUTTLE GROUND OPERATIONS

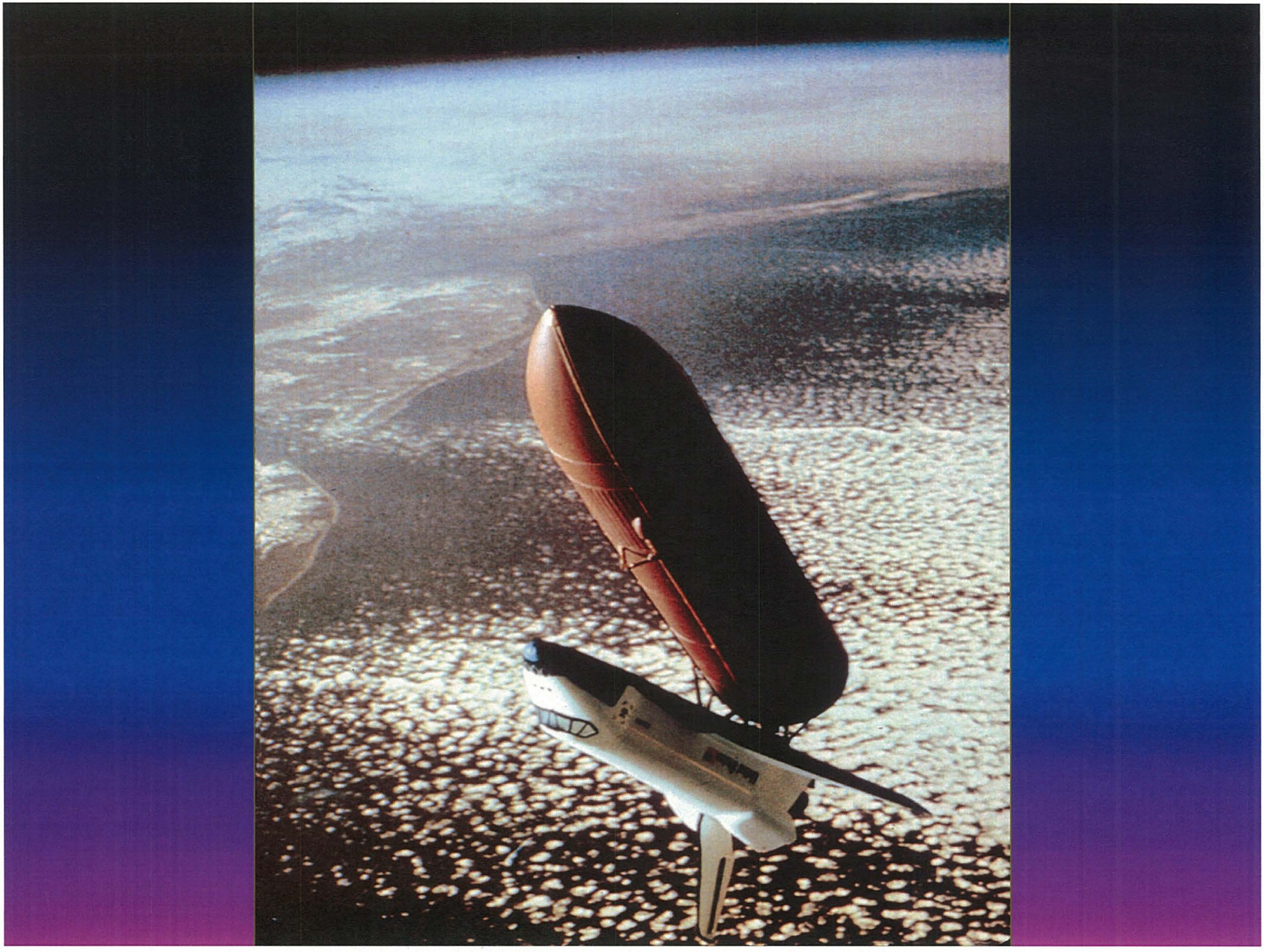
Space Shuttle Launch

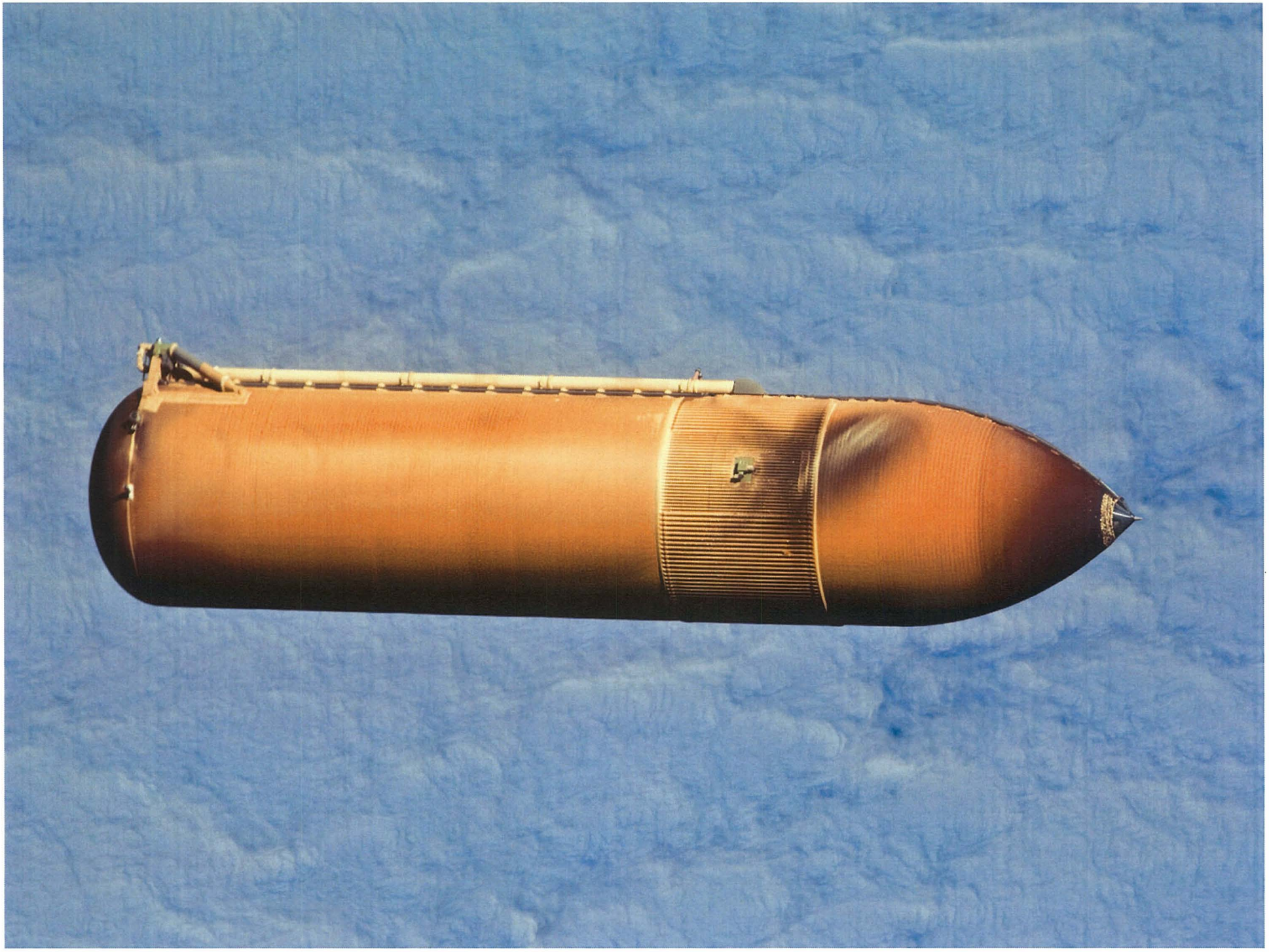




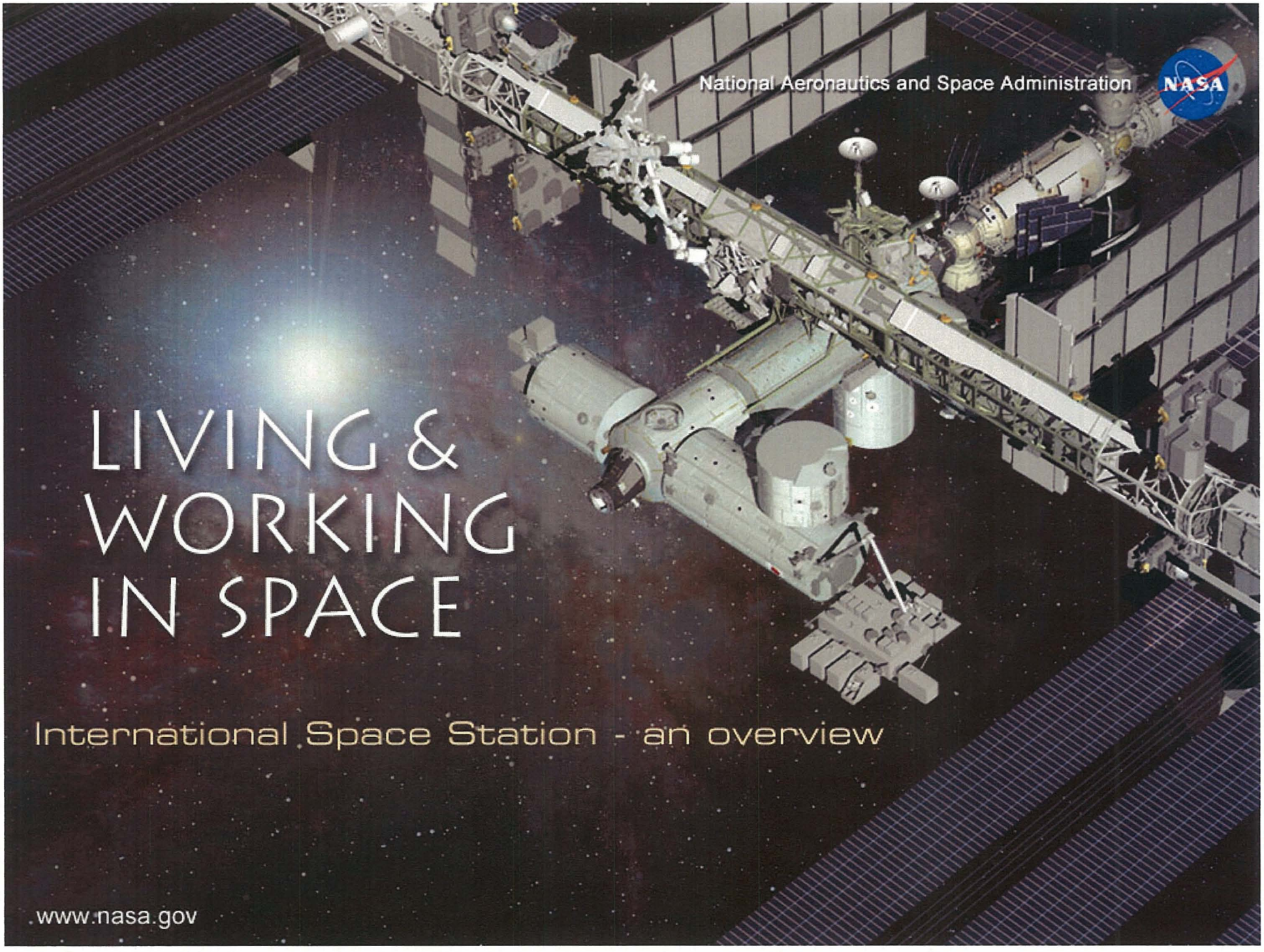




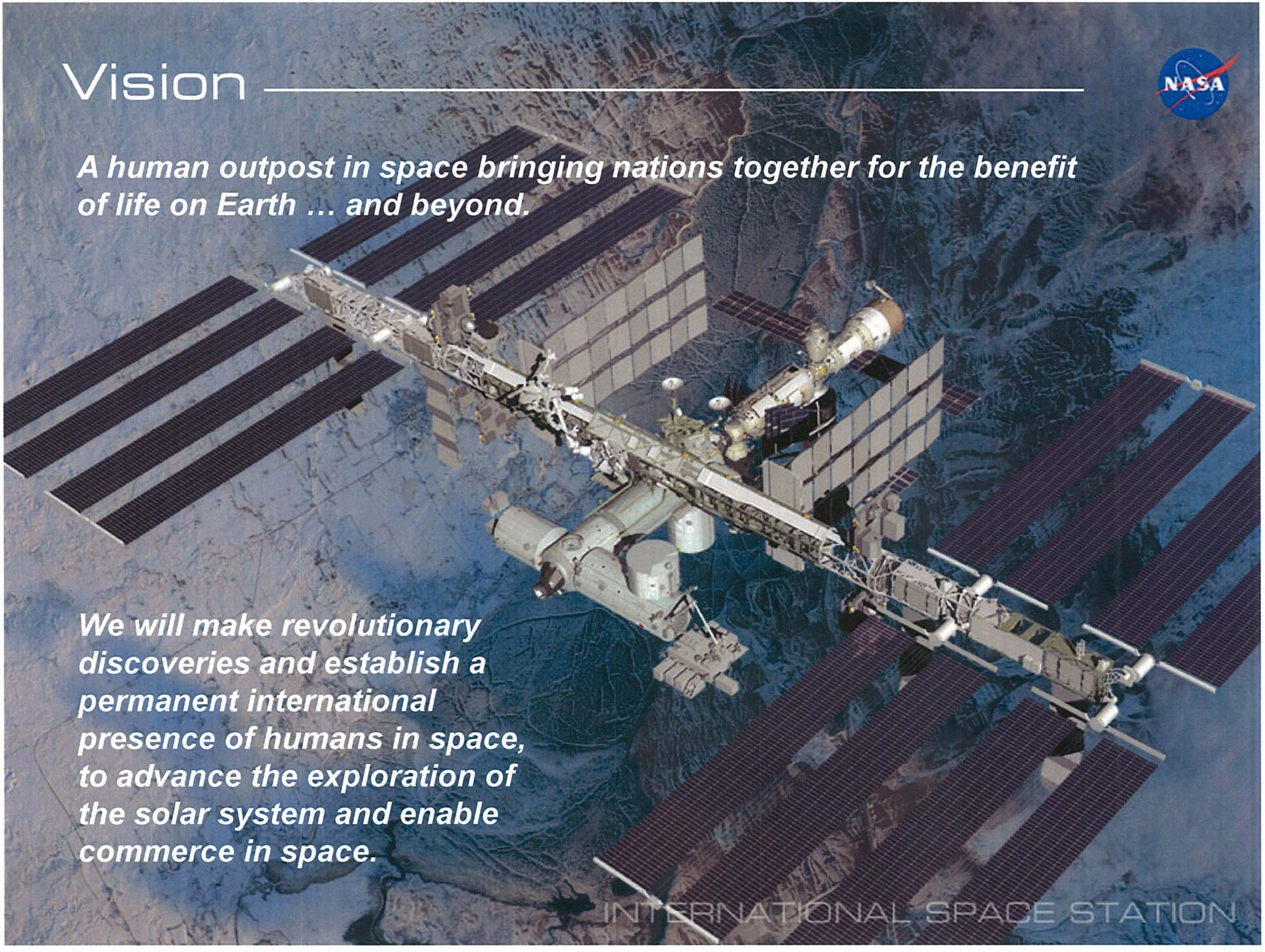





United States


National Aeronautics and Space Administration
NASA
LIVING &
WORKING
IN SPACE
International Space Station - an overview
www.nasa.gov

Vision



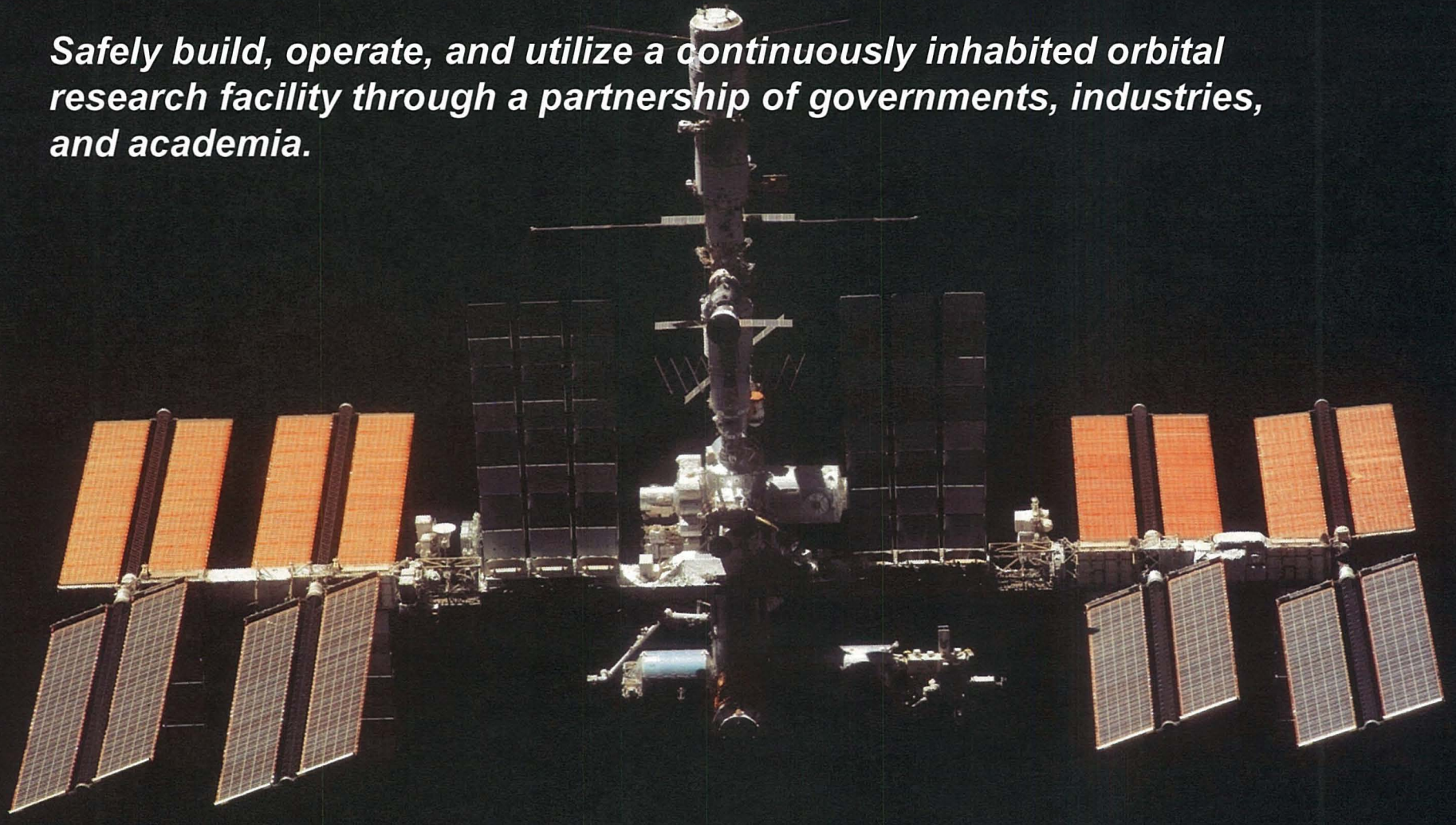
A human outpost in space bringing nations together for the benefit of life on Earth … and beyond.

We will make revolutionary discoveries and establish a permanent international presence of humans in space, to advance the exploration of the solar system and enable commerce in space.

INTERNATIONAL SPACE STATION

Mission

Safely build, operate, and utilize a continuously inhabited orbital research facility through a partnership of governments, industries, and academia.



ISS Today

dimensions:
240 ft. long, 291 ft. wide, 45 ft. high, 29,560 cubic feet of living space.

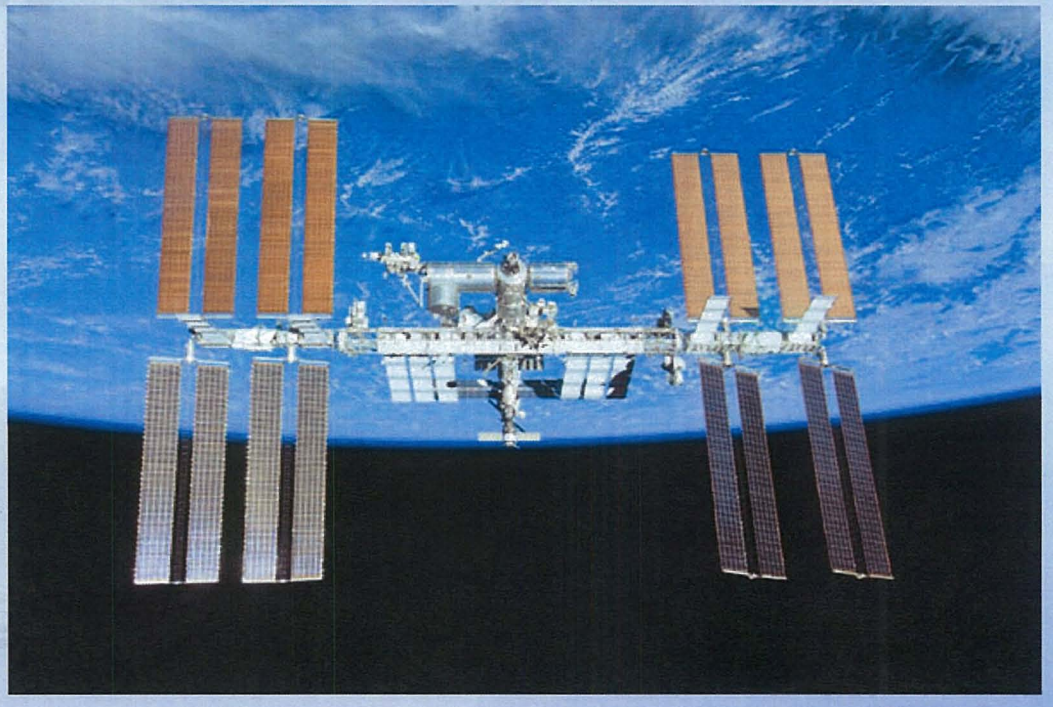
weight:
815,520 lbs.

science capabilities:
laboratories from four international space agencies – U.S., Russia, Europe, and Japan.

orbital inclination/path:
51.6 degrees, covering 90% of the world's population.

altitude:
approximately 220 miles above the Earth.

speed:
17,500 miles per hour, orbiting the Earth 16 times a day.

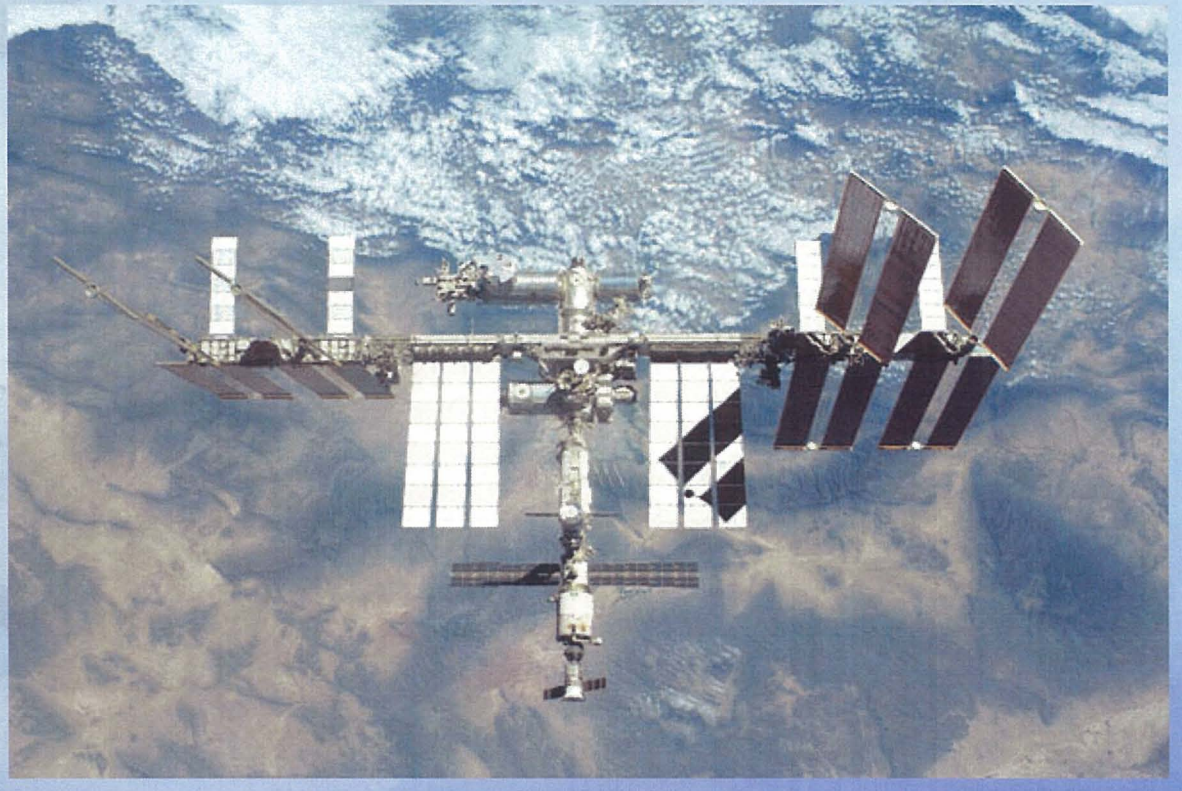


The International Space Station is more powerful, and 4 times larger than any human space craft ever built.

ISS Today

Multi-dimensional challenges:

- ***Integrating International Partners***
- ***Engineering Excellence***
- ***Prioritizing Science***
- ***24/7 Space Operations***
- ***Organization, Budget, and People***



Ten years

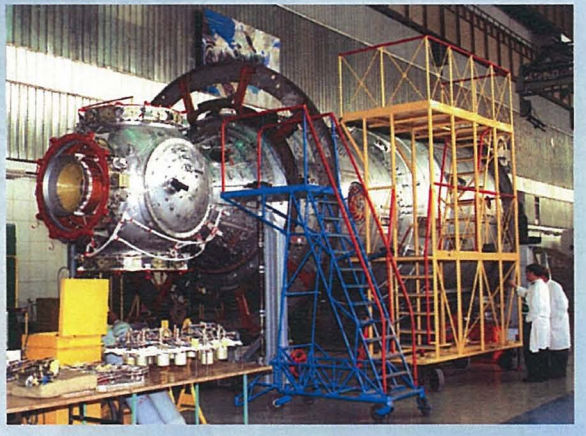
of continued human presence…

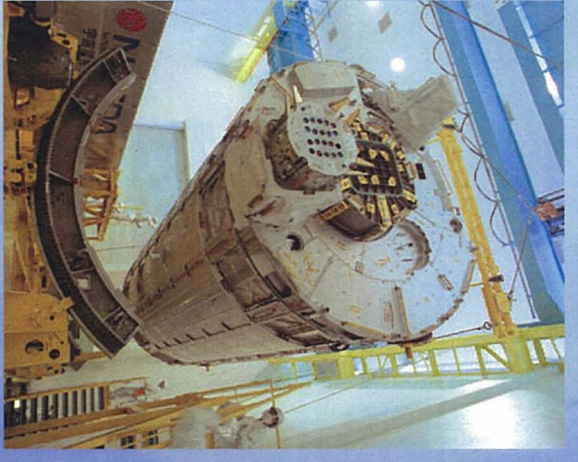
Five international partners

INTERNATIONAL SPACE STATION

Elements are constructed around the world

and come together in space with hairline tolerance.





110 flights to the ISS so far (11/98 - 4/11)

35 shuttle flights

* crew member exchange

STS-88 - U.S. Node
STS-96 - Logistics
STS-101 - Logistics
STS-106 - Logistics
STS-92 - Z-1 Truss
STS-97 - Solar Array
STS-98 - Destiny Lab
STS-102 - MPLM
STS-100 - Canadarm2
STS-104 - U.S. Airlock
STS-105* - MPLM
STS-108* - Expedition 4
STS-110 - S0 Truss
STS-111* - Science, Expedition 5
STS-112 - S1 Starboard Truss
STS-113* - P1 Port Truss, Expedition 6
STS-114 - Logistics
STS-121 - Logistics
STS-115 - P3/P4 Truss
STS-116* - P5 Integrated Truss, Expedition 14
STS-117* - S3/S4 Truss, Expedition 15
STS-118 - S5 Truss
STS-120* - Harmony module
STS-122* - Columbus module
STS-123* - "Kibo" module, "Dextre" robotic arm
STS-124* - second "Kibo" module
STS-126 - Logistics
STS-119* - S6 Truss Solar Array
STS-127* - "Kibo" platforms
STS-128* - MPLM
STS-129* - spare hardware on 2 logistics pallets
STS-130 - Node 3/Cupola
STS-131 - MPLM
STS-132 - MRM1, spare antenna
STS-133 – PMM "Leonardo", 1 logistics pallet

71 Russian flights

2 Proton, (FGB, Service Module)
2 Unmanned Soyuz (Pirs and Poisk docking compartments)
26 Soyuz crew vehicles
41 Progress re-supply ships

2 European flights

2 ATV re-supply ship

2 Japanese flights

2 HTV re-supply ship

INTERNATIONAL SPACE STATION

Present ISS launch vehicles

Shuttle

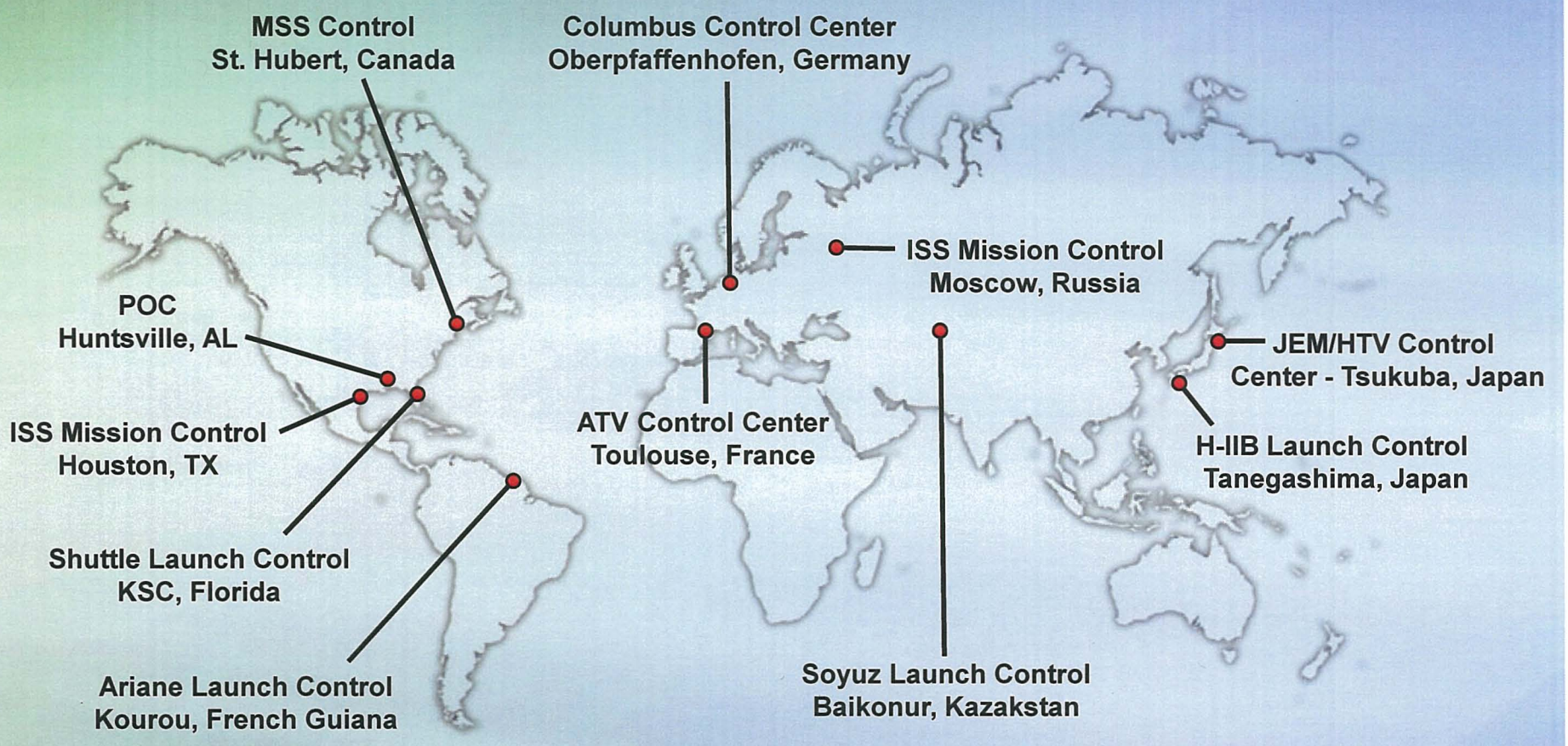
Proton

Soyuz

Ariane

HIIB

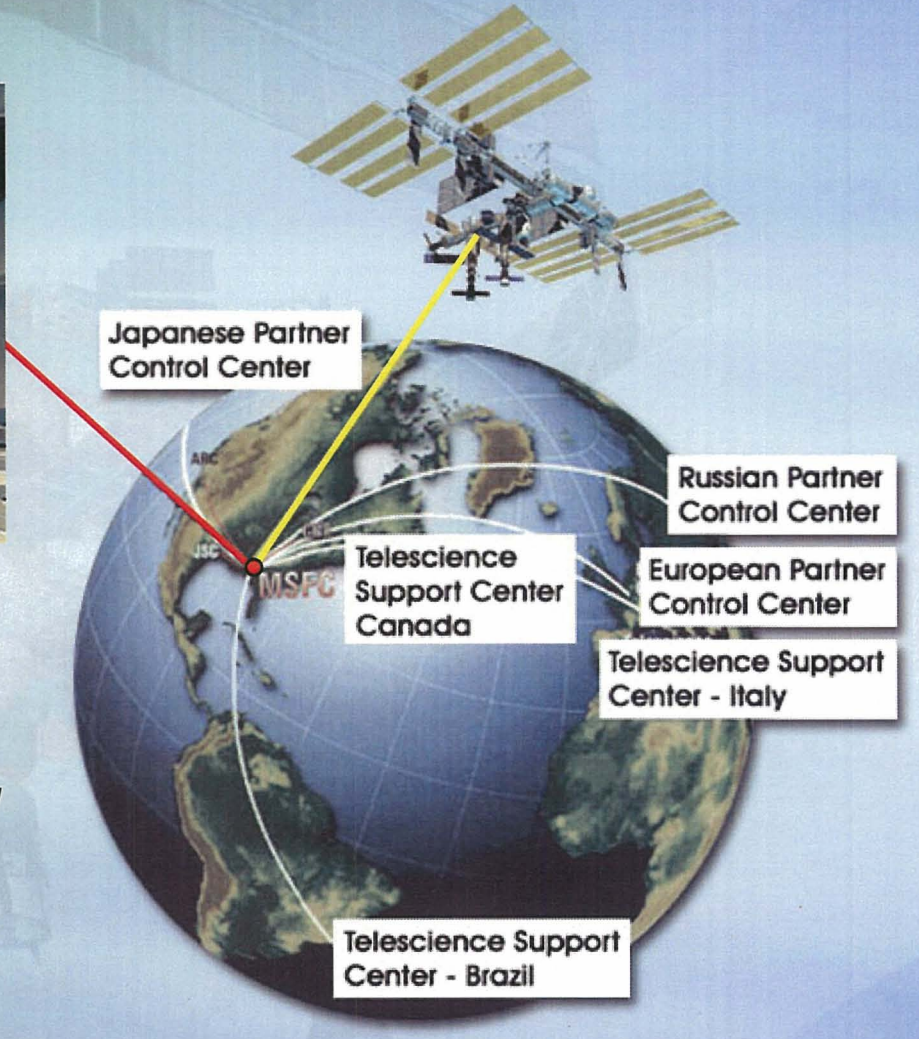
NASA and international partner control centers



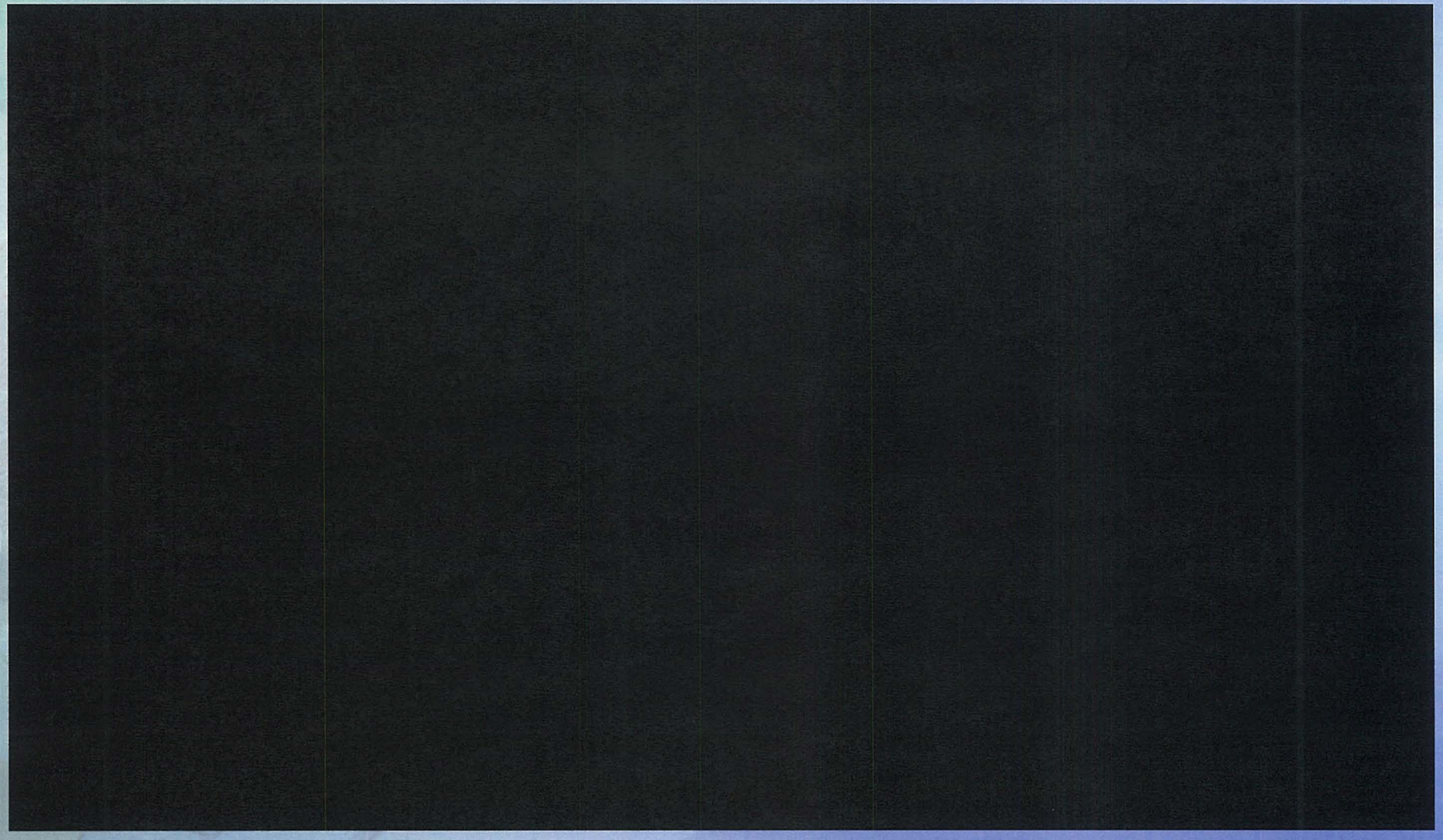
Payload Operations Centers

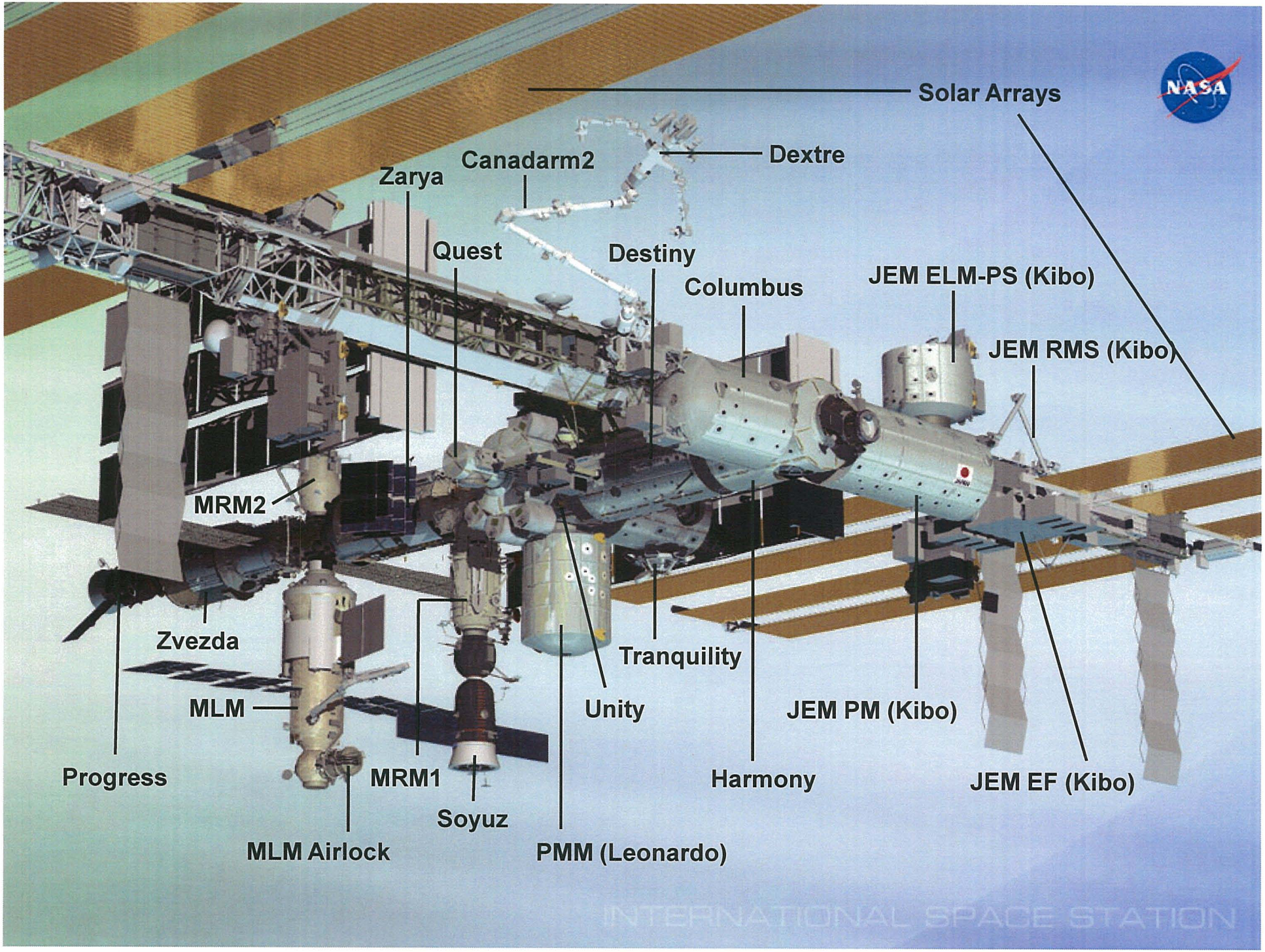
ISS Payload Operations Center - MSFC

From laptop, to ISS, to the world

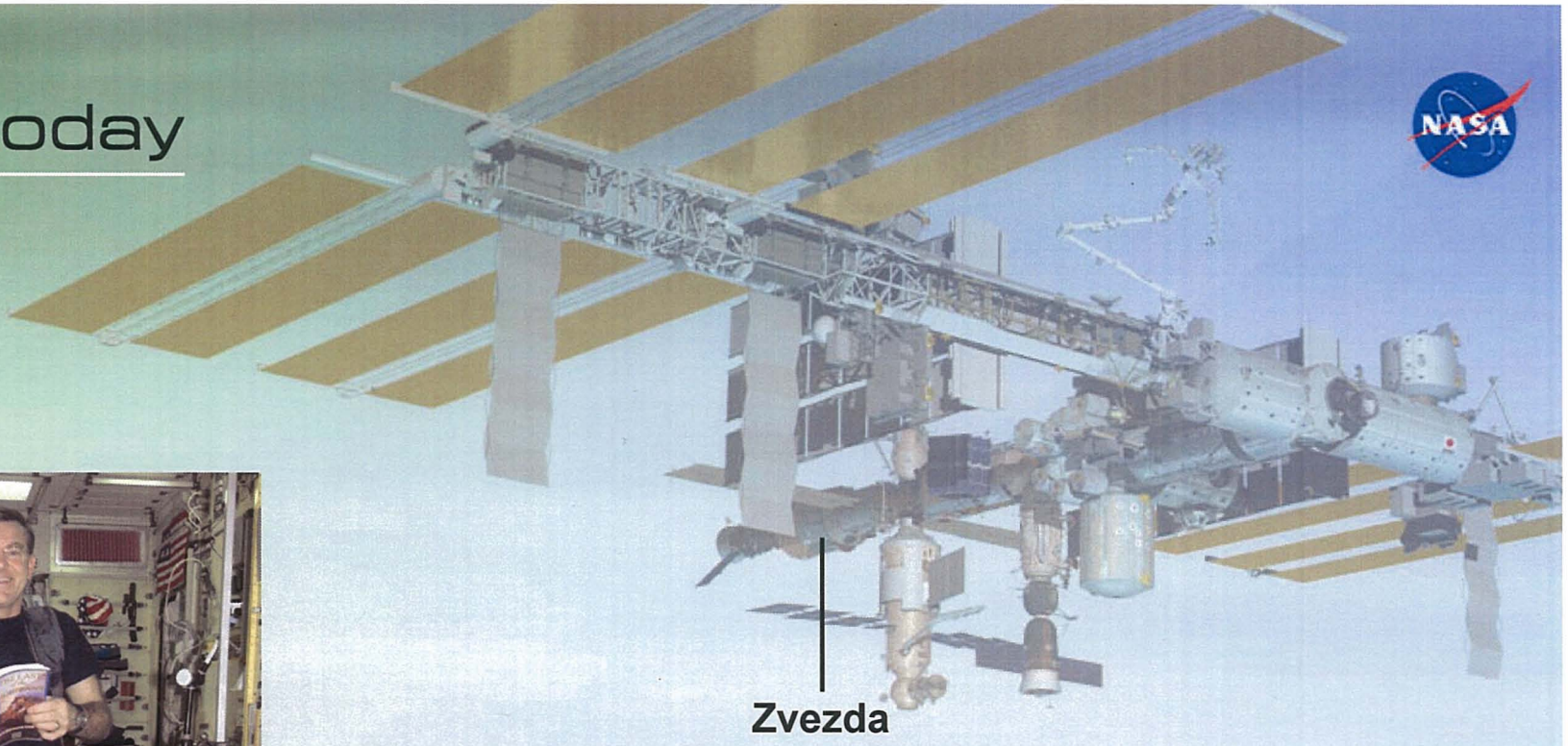


ISS Assembly Sequence



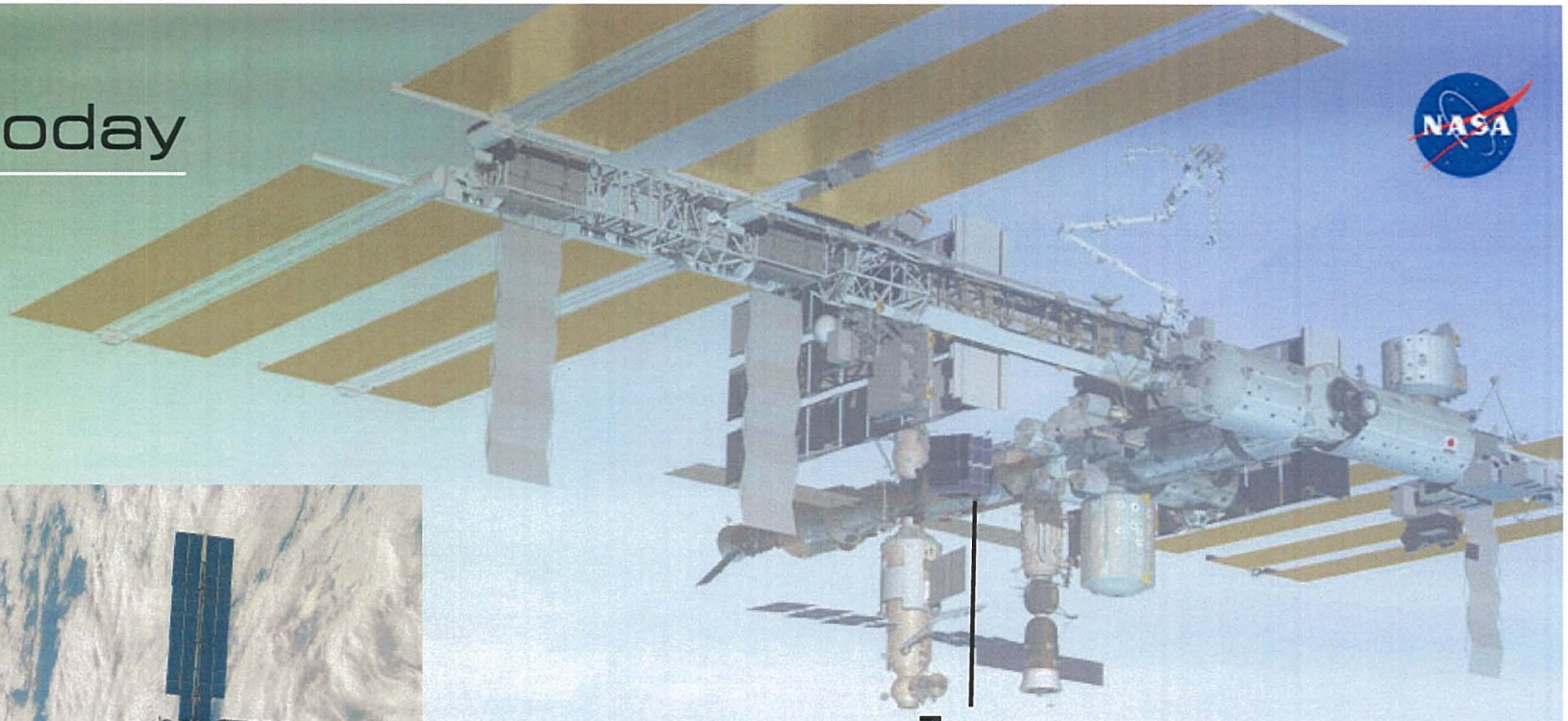

Solar Arrays
Dextre
Canadarm2
Zarya
Quest
Destiny
Columbus
JEM ELM-PS (Kibo)
JEM RMS (Kibo)
MRM2
Zvezda
Tranquility
MLM
Unity
JEM PM (Kibo)
Progress
MRM1
Harmony
JEM EF (Kibo)
Soyuz
MLM Airlock
PMM (Leonardo)
INTERNATIONAL SPACE STATION

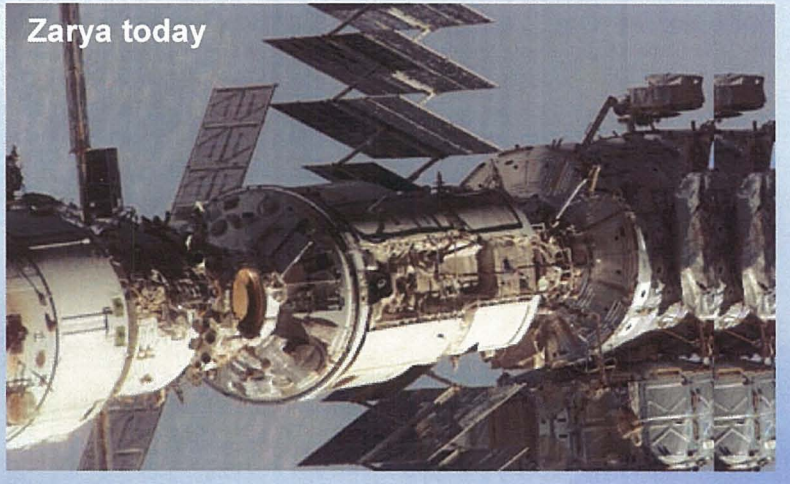
ISS today



"Zvezda", or the Service Module, serves as the Station's crew quarters, providing a place for the astronauts to eat, live, rest, exercise, and conduct science experiments.

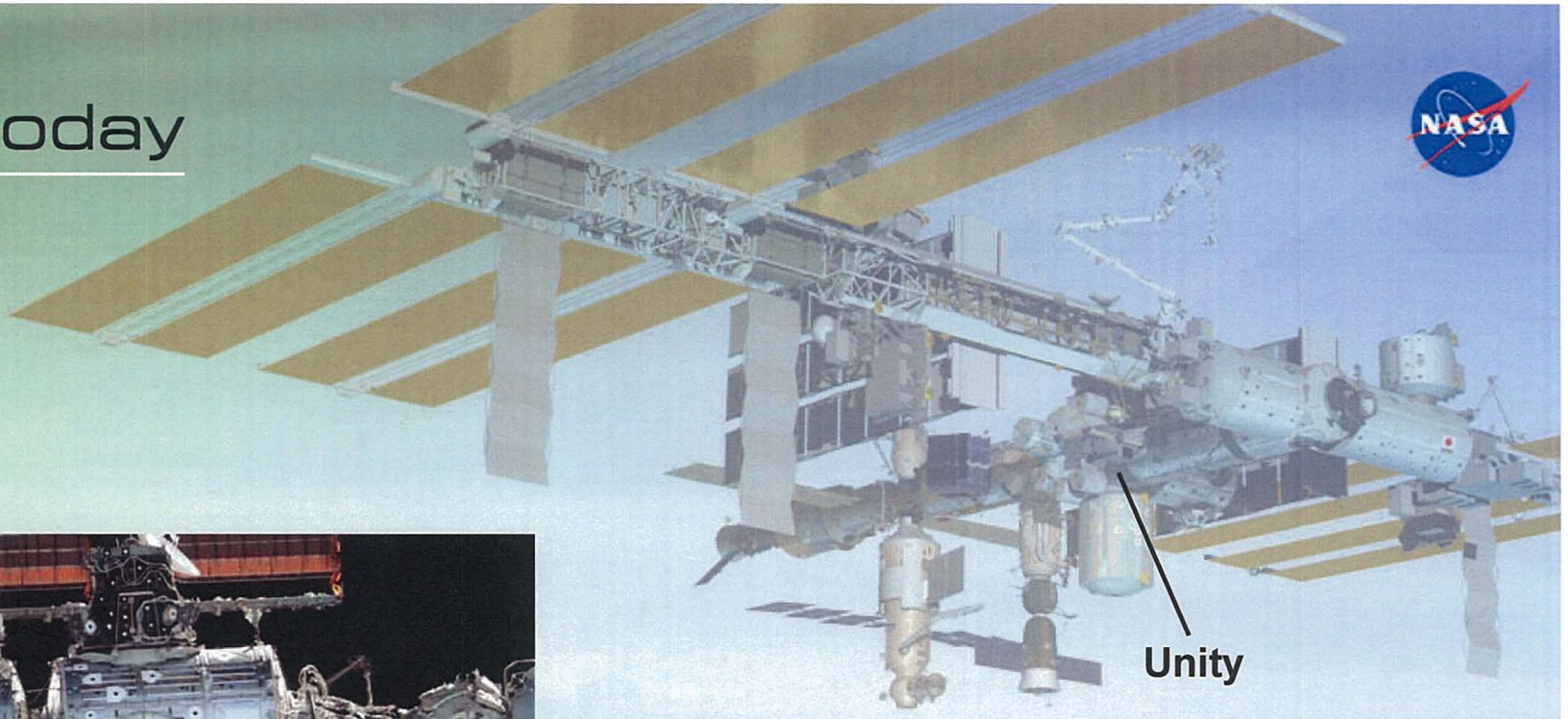
ISS today

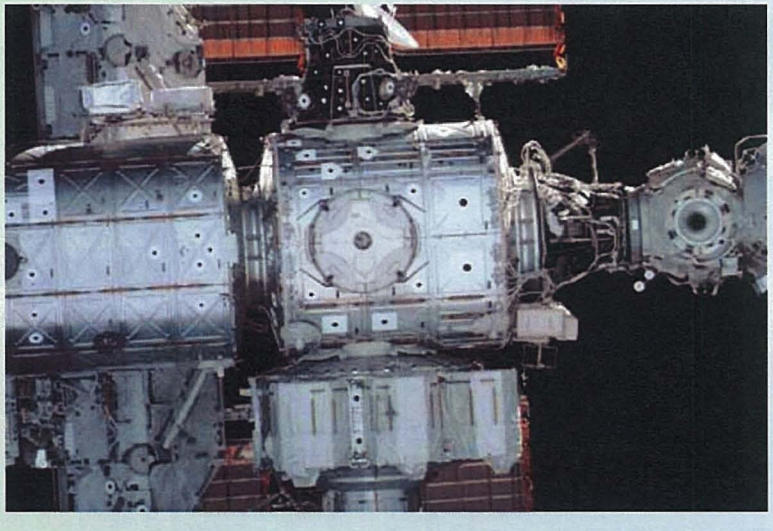




The Russian built Zarya, or functional cargo block (FGB) was the initial building block, control center, and propulsive power of the Station.

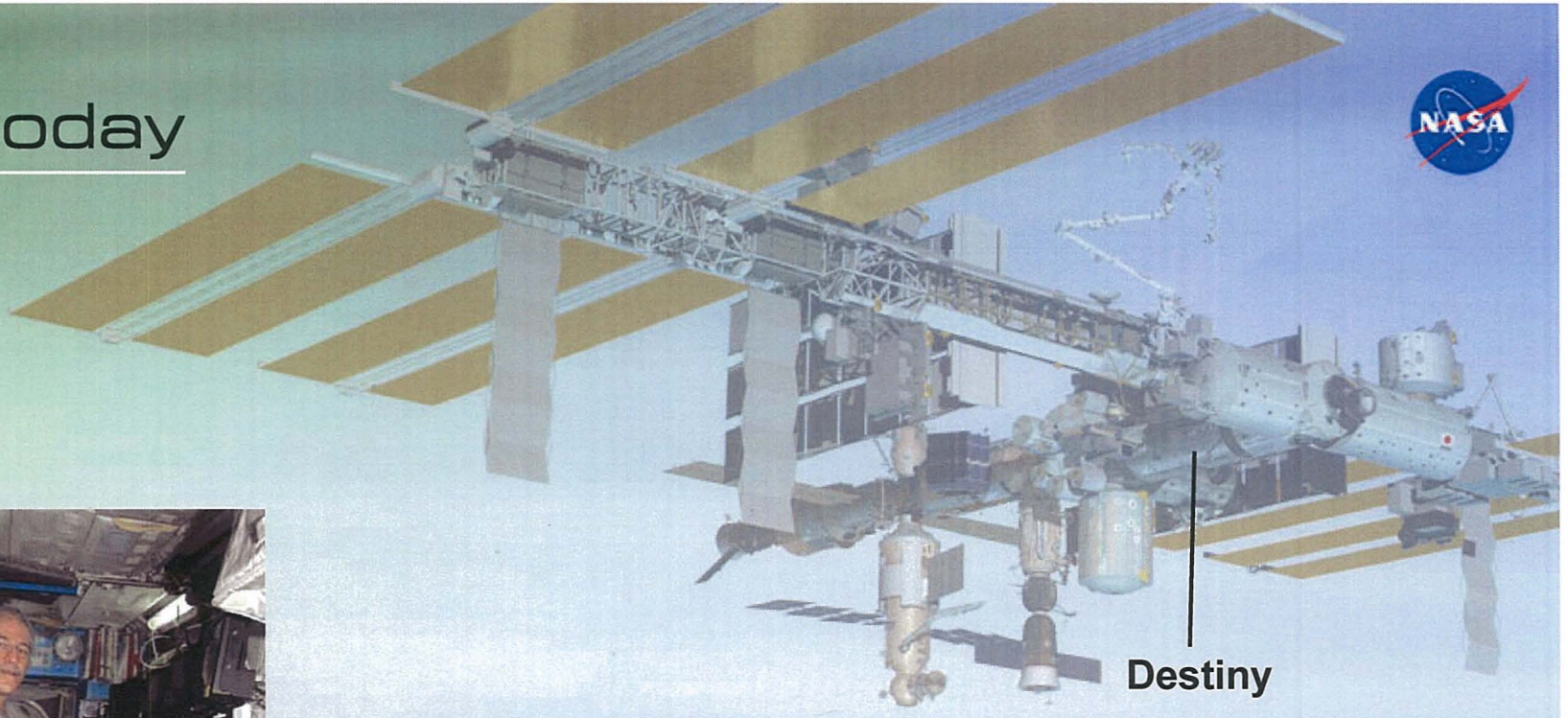
ISS today





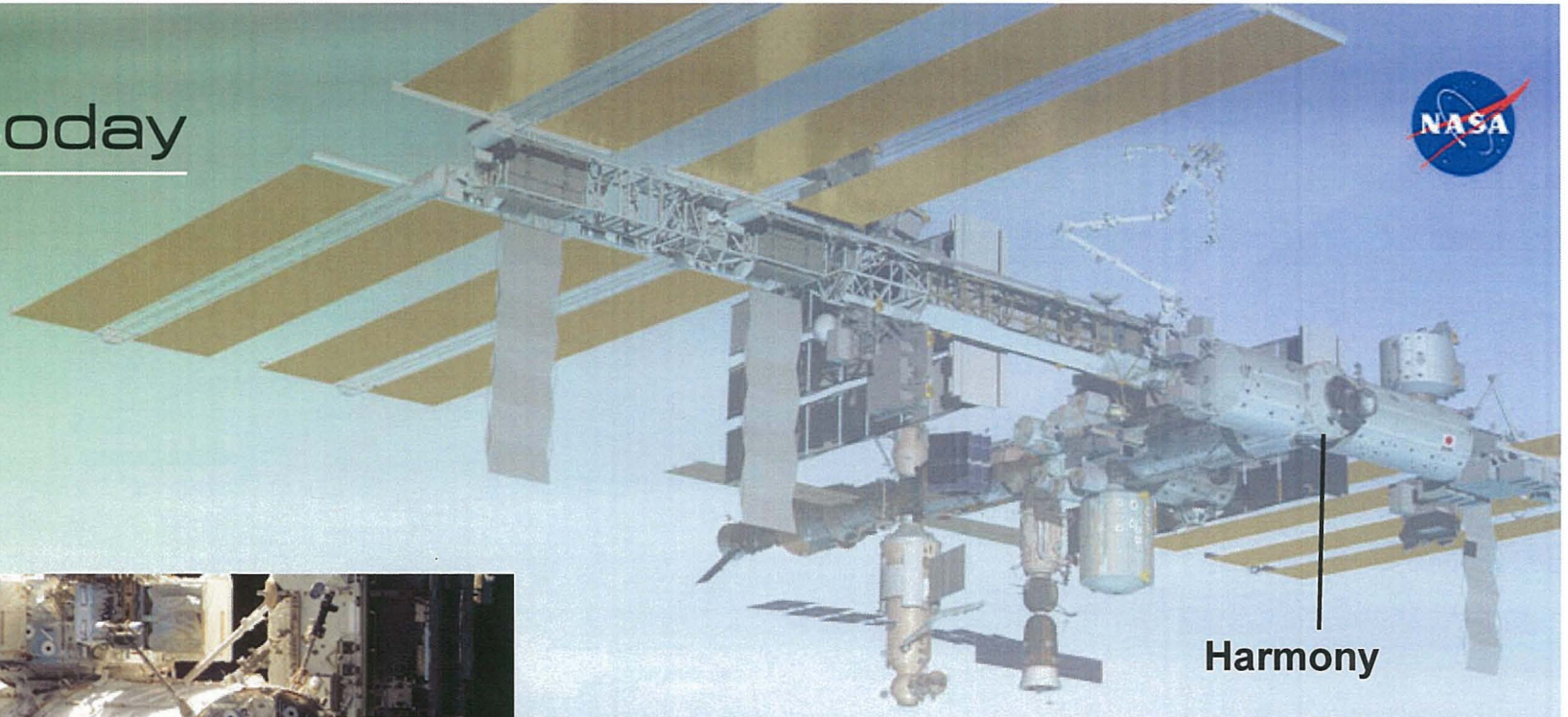
With six docking ports, "Unity" (Node1) is the nexus of the Station's U.S. segment connecting the lab, airlock, and solar array structures.

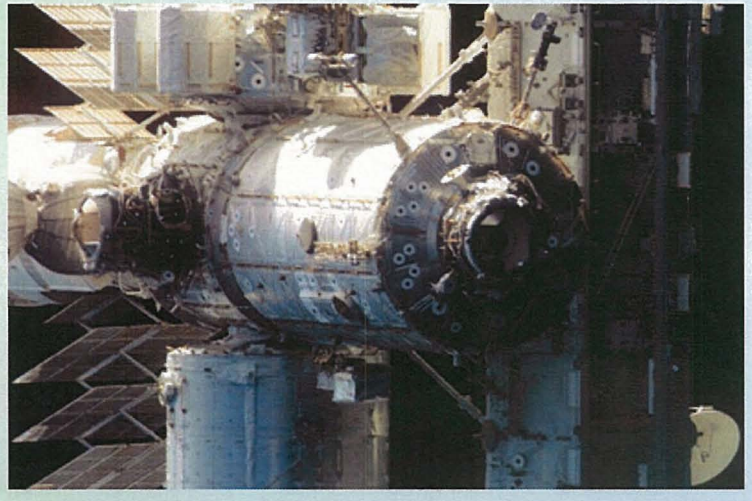
ISS today

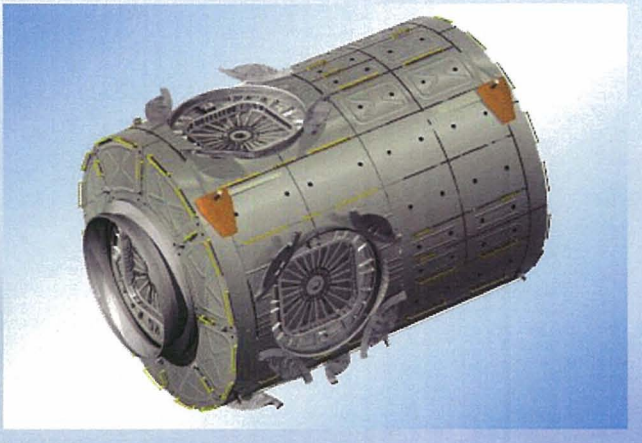


The Station's main U.S. science facility is the home of four different types of racks, where ongoing experiments are performed and monitored by the crew.

ISS today

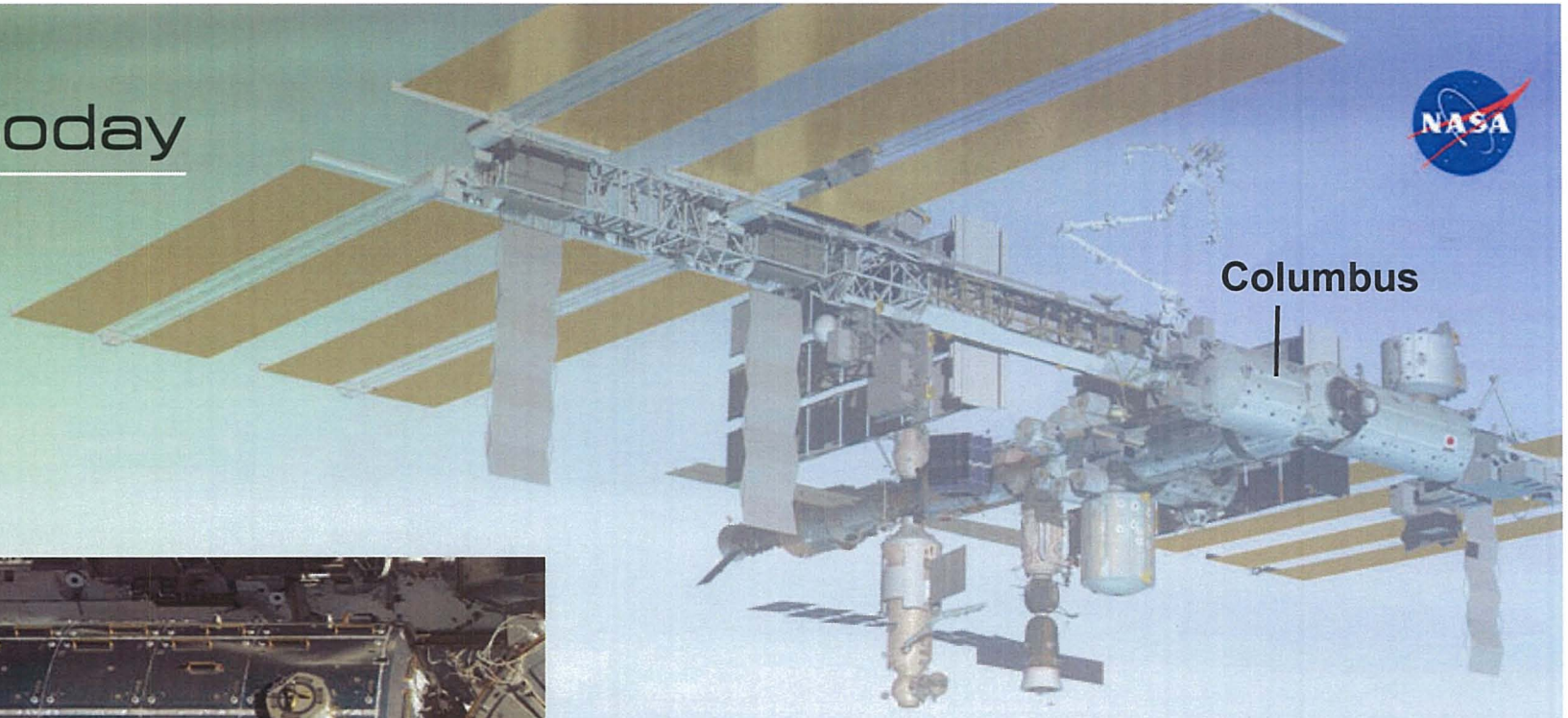


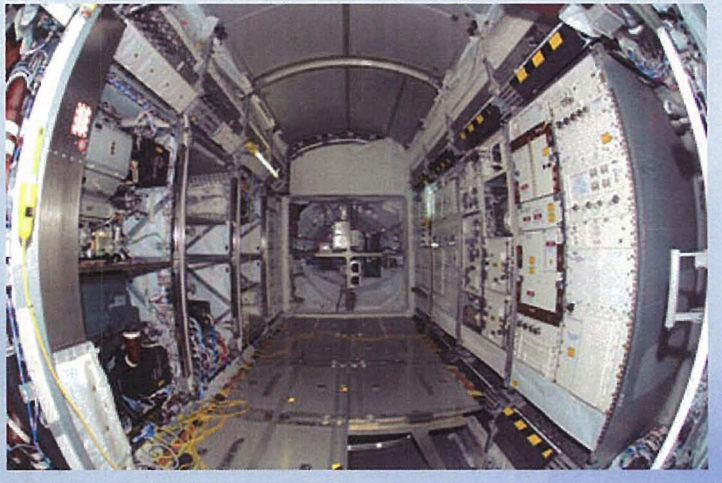




Node 2, or "Harmony", acts as a hub connecting the U.S. science lab "Destiny" to Europe's "Columbus" lab and Japan's "Kibo".

ISS today

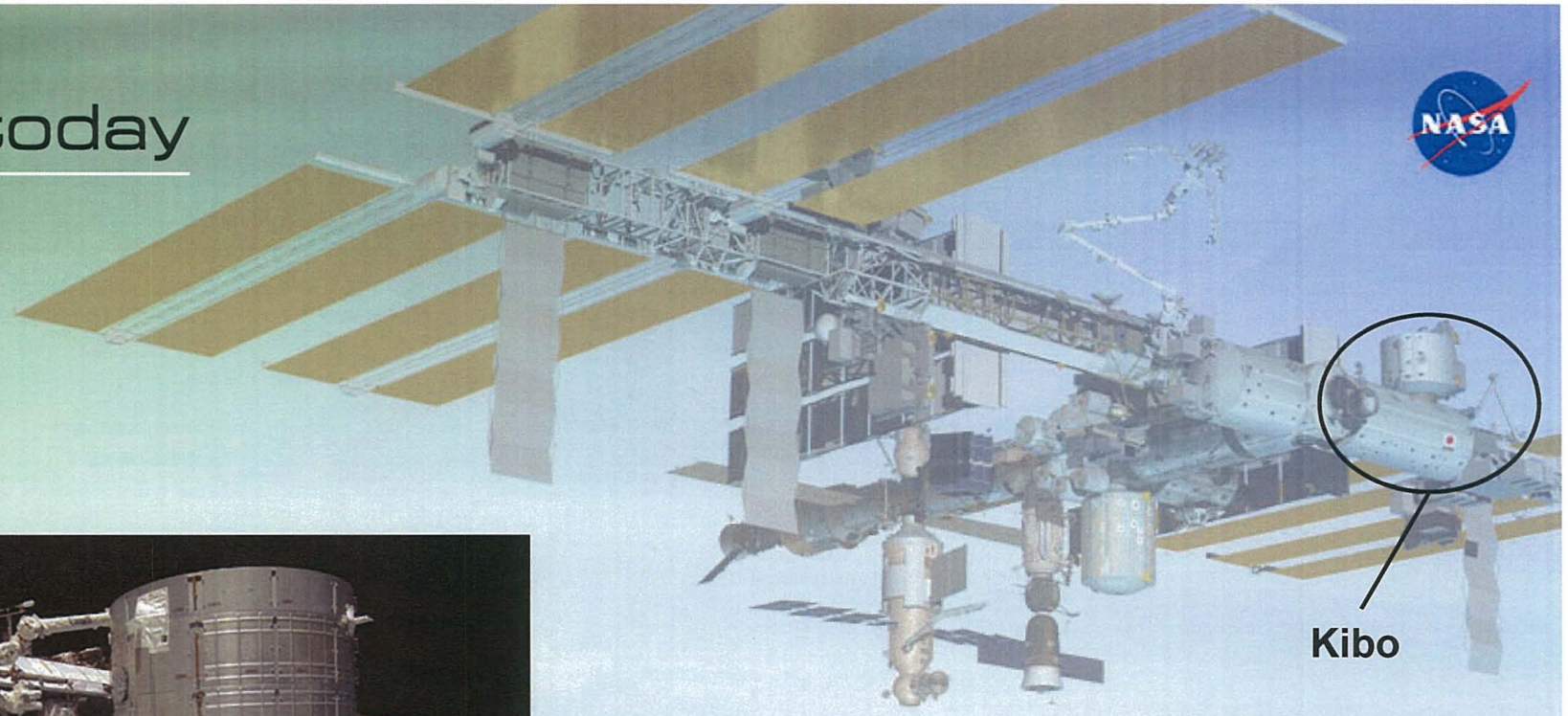


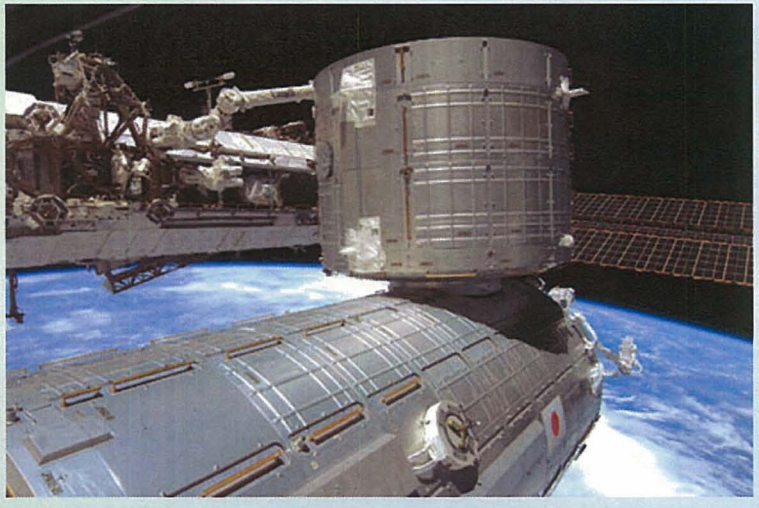


Europe's research laboratory was launched with five science experiment racks and has room for five more.

INTERNATIONAL SPACE STATION

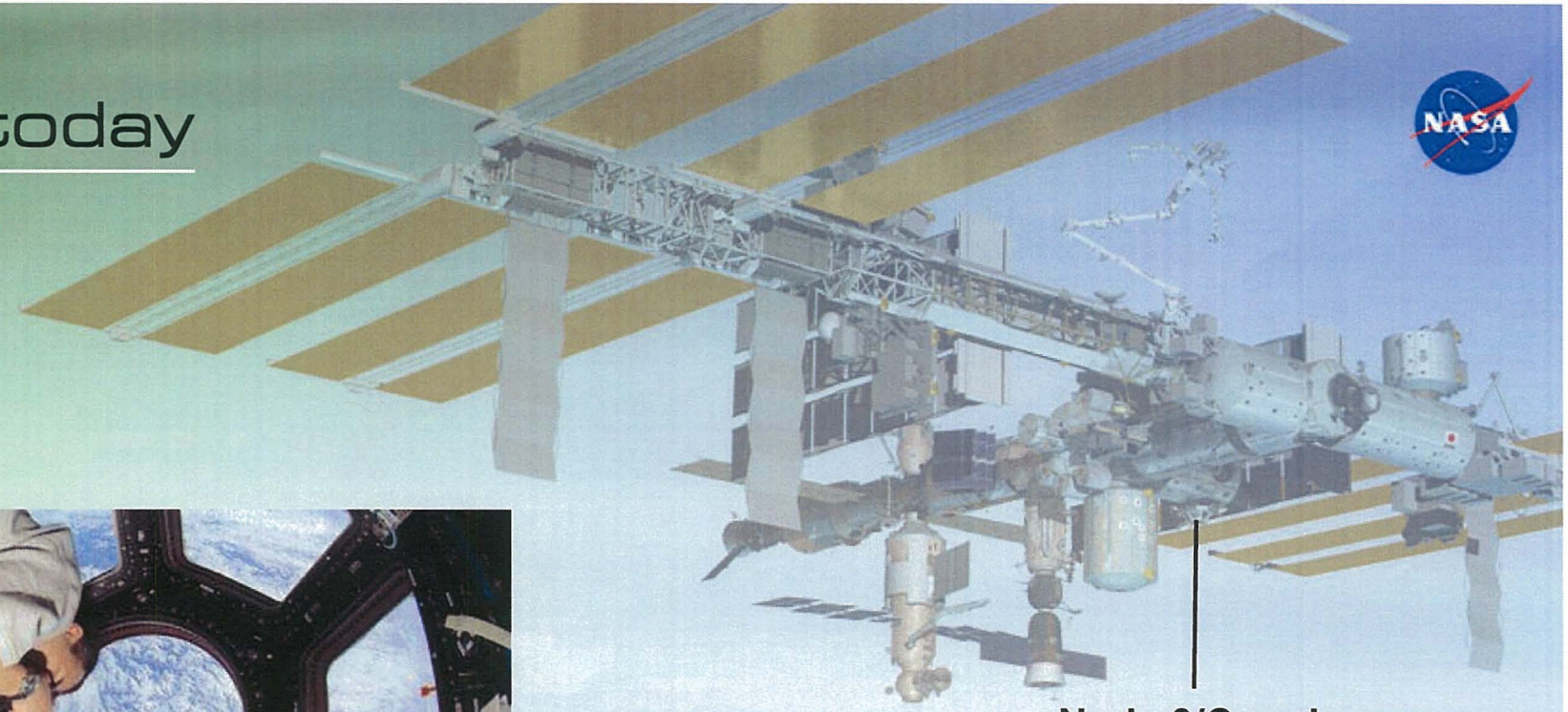
ISS today



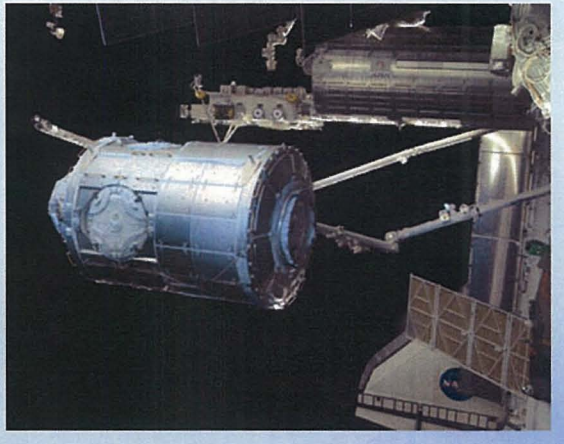


"Kibo" ("Hope"), is Japan's state of the art science lab consisting of two modules providing room to house ten racks - it also has it's own robotic arm (JRMS) outside the station.

ISS today

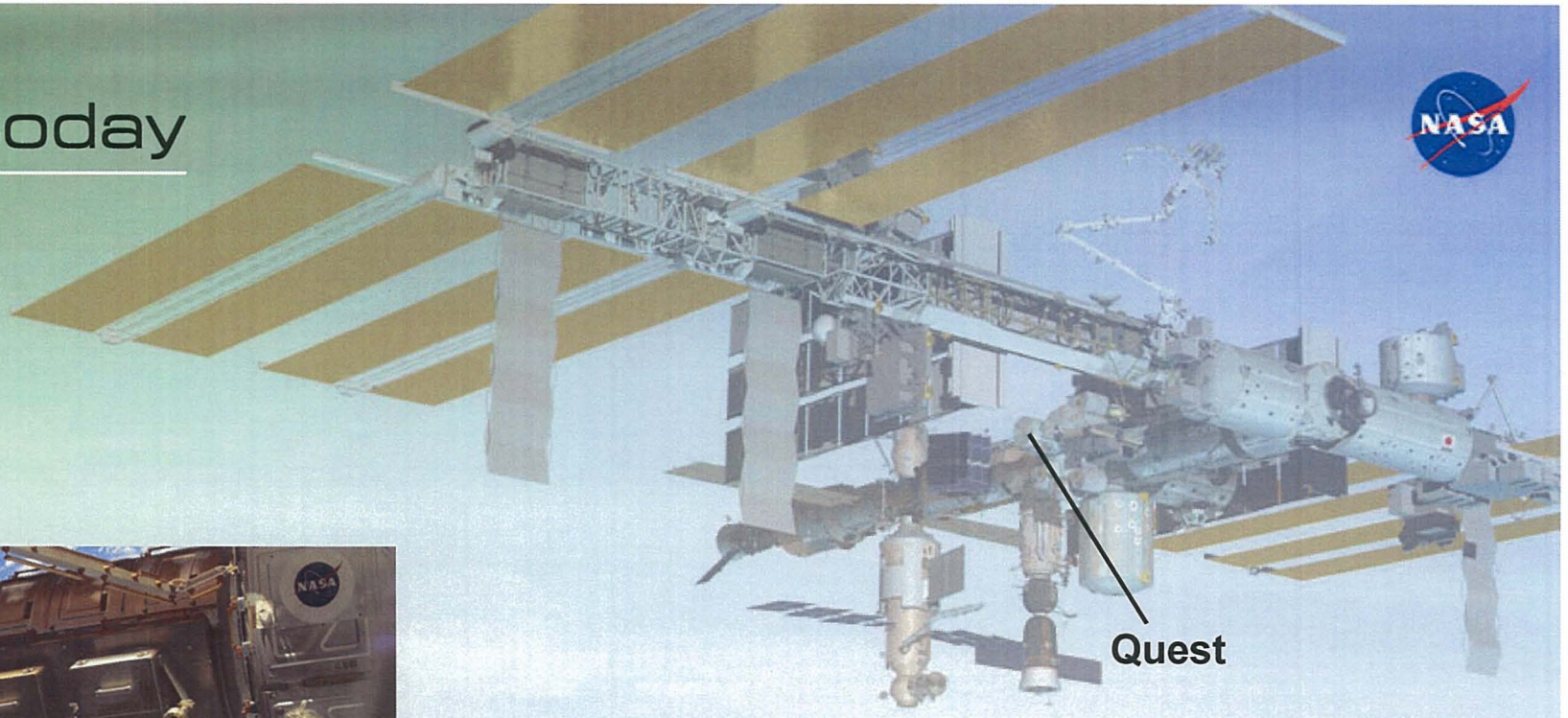


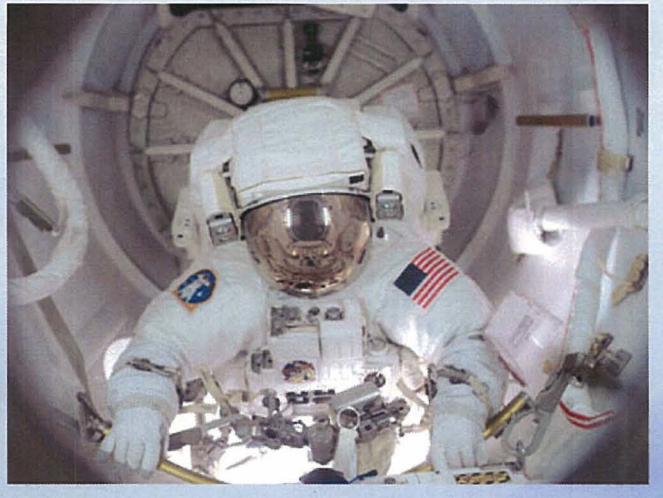
Node 3/Cupola



The European built Node 3, named "Tranquility", is the final connecting module to be added to the Station. Attached to the node is the Cupola, a robotic control station with seven windows providing a panoramic view of Earth, celestial objects, and visiting space craft.

ISS today

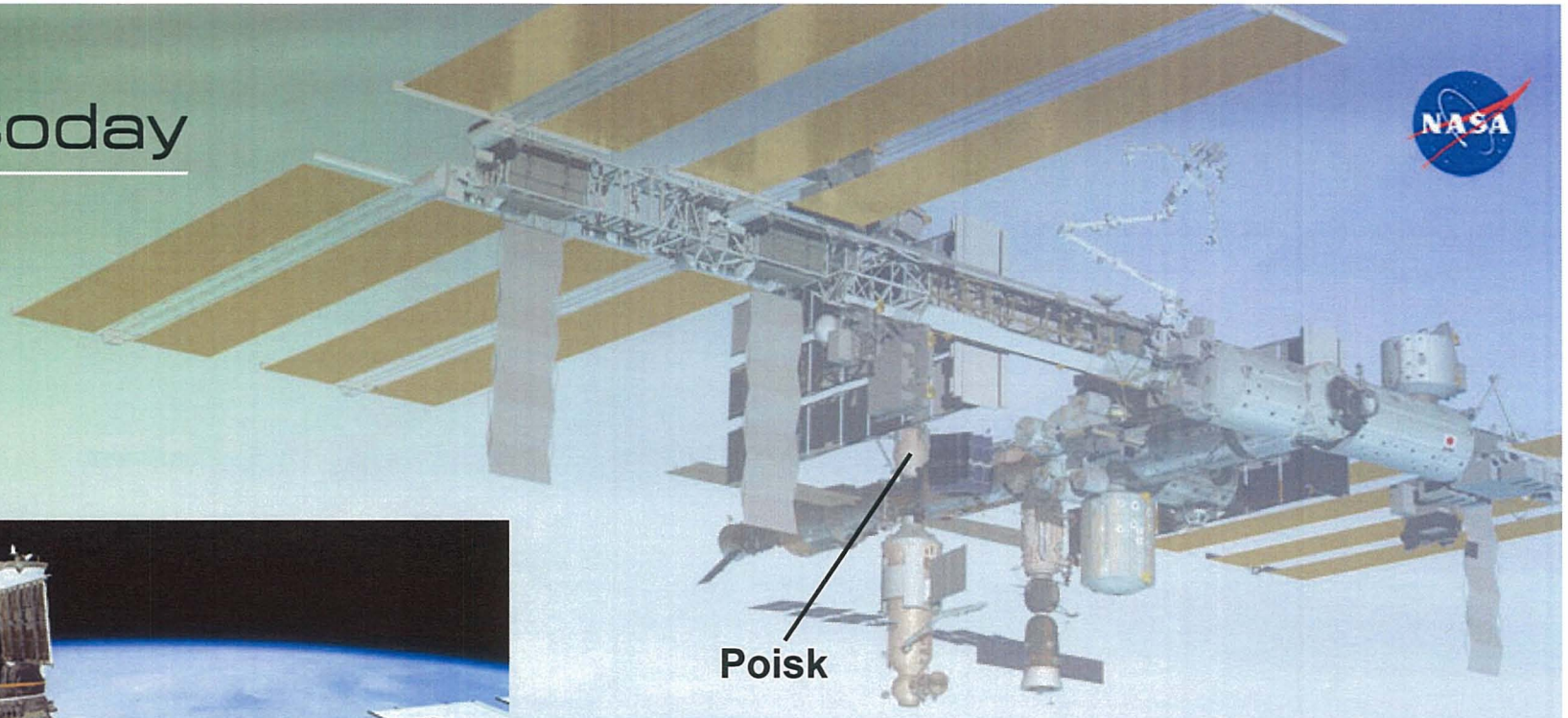




Astronauts exit the Station using the Joint Airlock "Quest" .

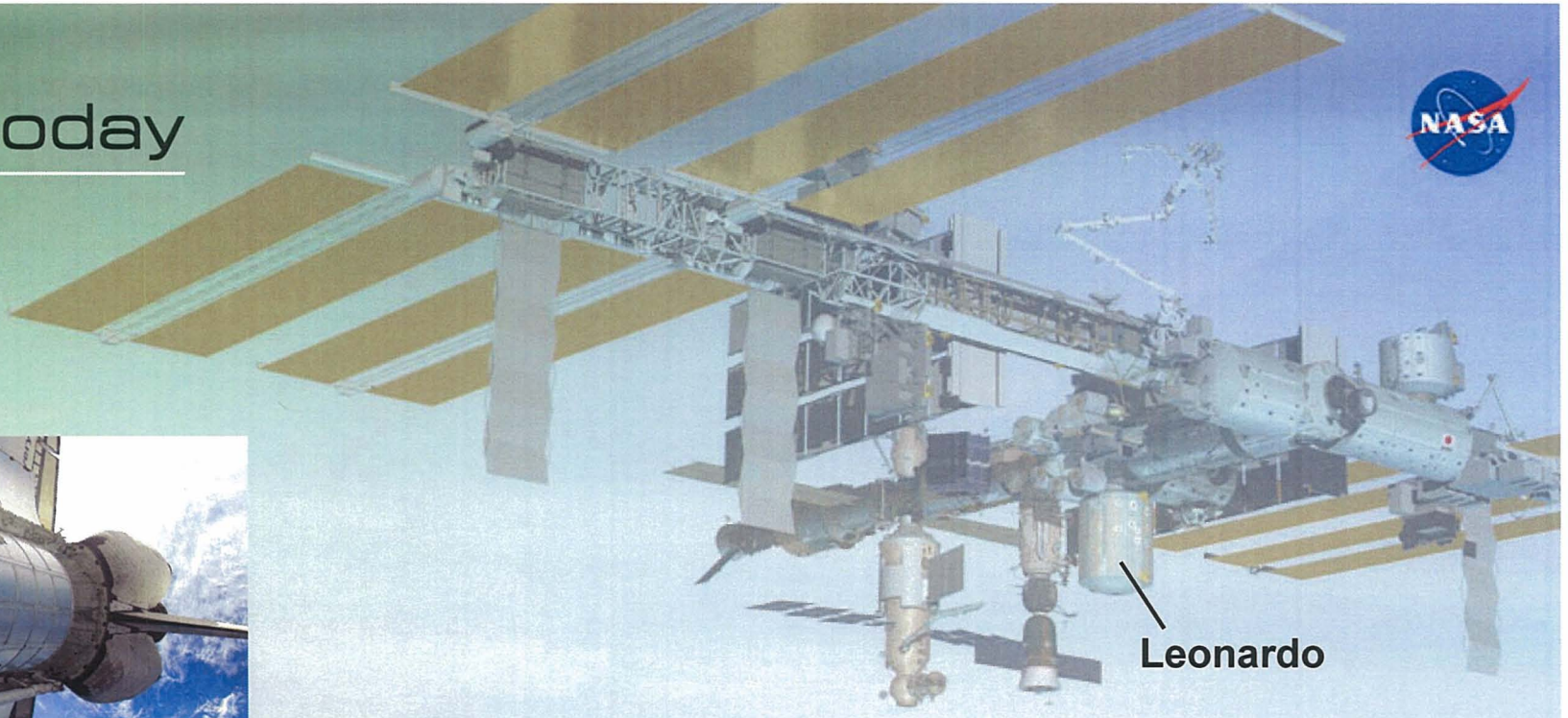
INTERNATIONAL SPACE STATION

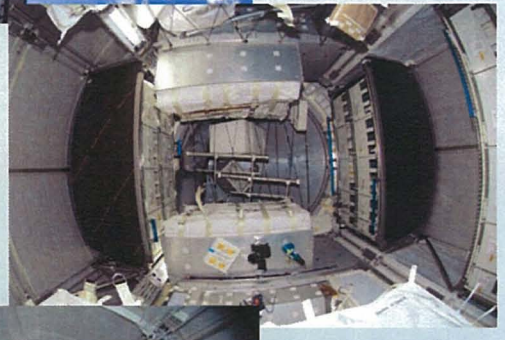
ISS today



The Russian built "Poisk" (MRM2), along with functioning as a mini research module, also serves as an extra airlock for spacewalkers, and a docking port for re-supply ships.

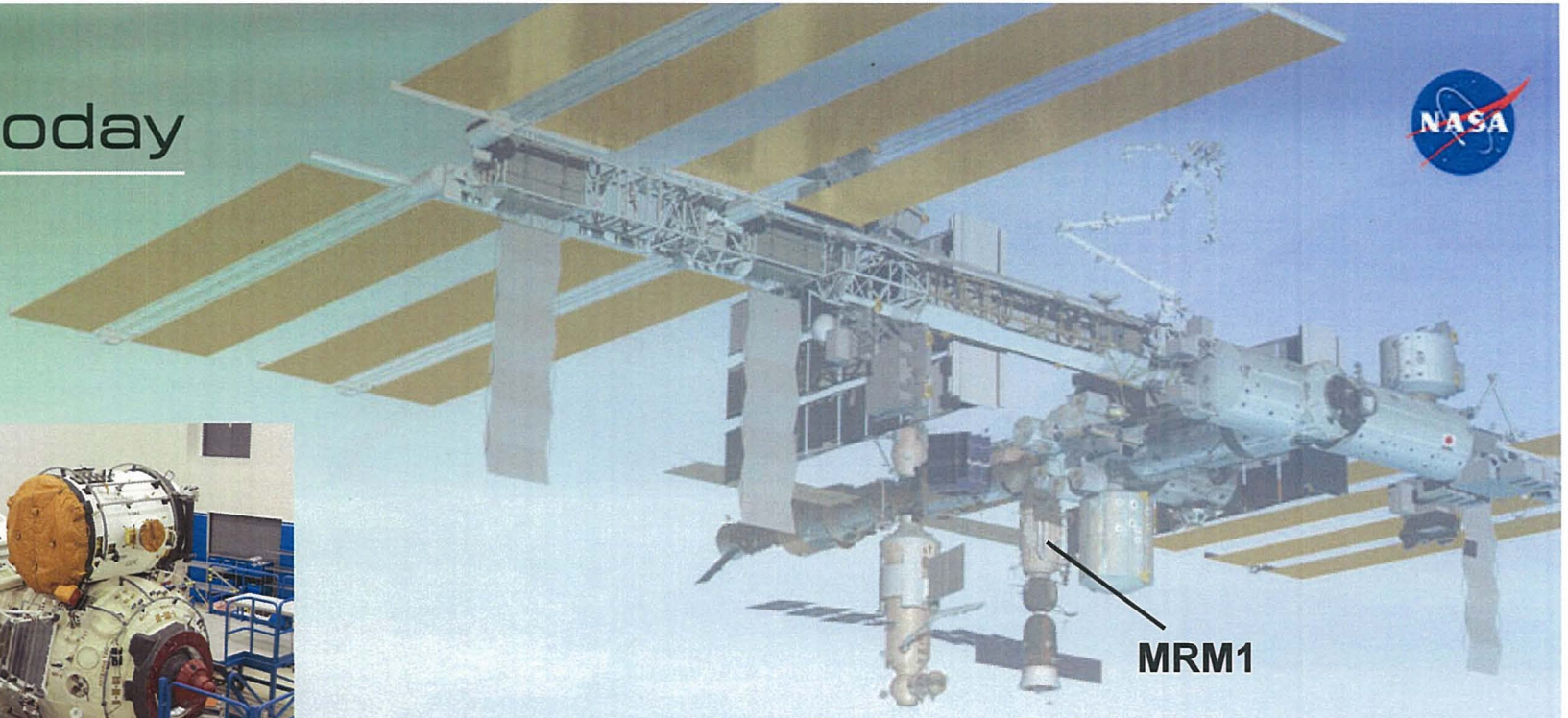
ISS today

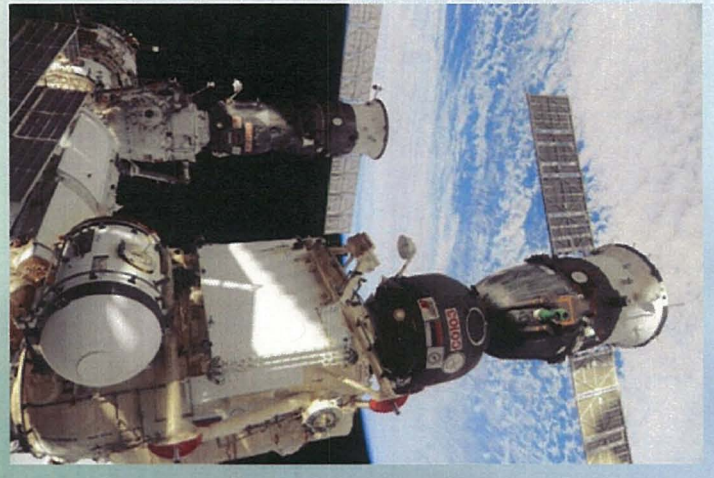




Leonardo is one of the three Multi-Purpose Logistics Modules (MPLM) built by the European Space Agency to ferry supplies, equipment and other cargo to and from the Station via the shuttle's payload bay. Later this year space shuttle Discovery will deliver the modified module one last time (STS-133), after which it will serve as a permanent pressurized storage facility for the crew.

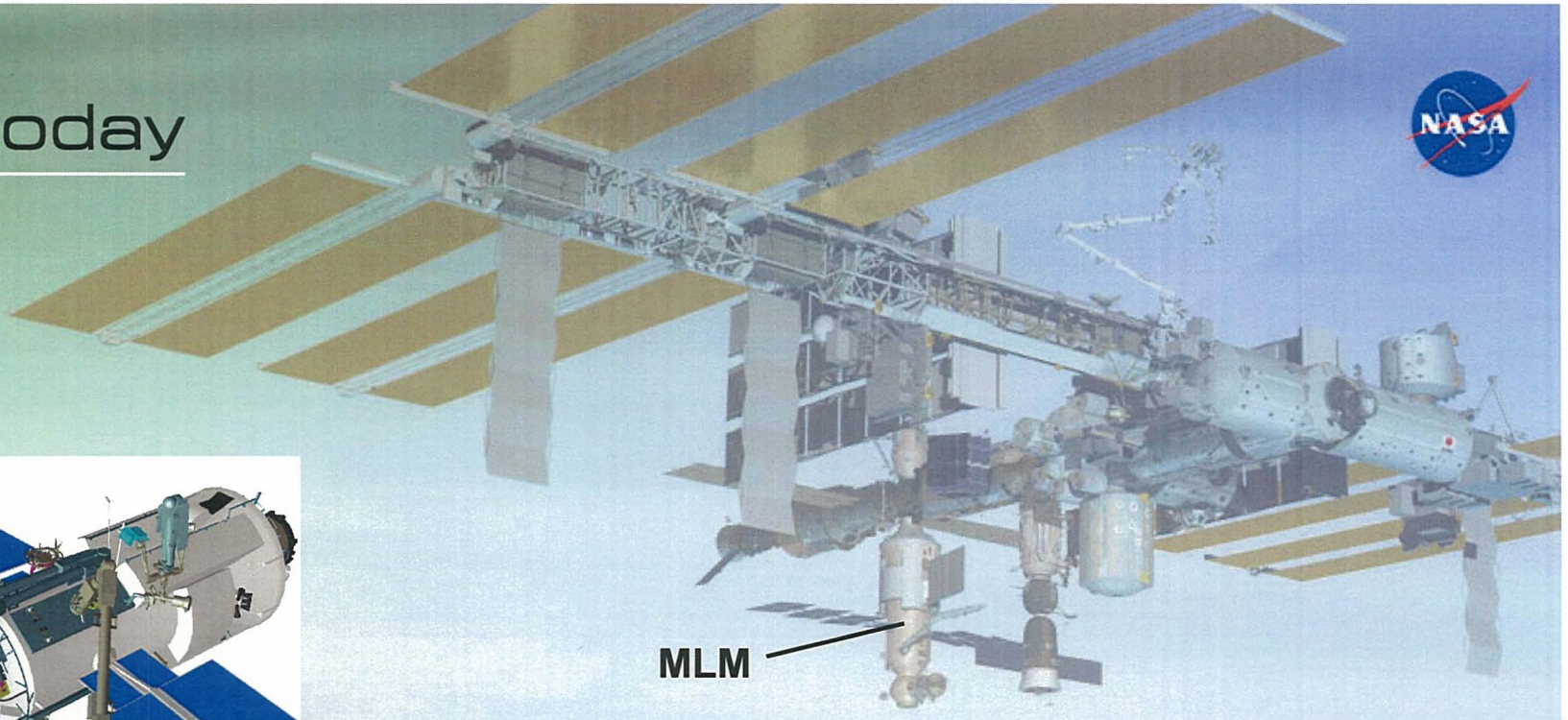
ISS today





The Russian built MRM1 (Mini Research Module) is primarily used for cargo storage and payload operations. It also provides a fourth docking port on the Russian operation segment of the station, and on it's shell carries outfitting equipment for a future Russian lab module (MLM scheduled to launch in 2012).

ISS today



Once docked to the Zvezda module the MLM (Multipurpose Laboratory Module) will become Russia's primary research module. It will also add to the Station an additional docking port/airlock and provide backup attitude control. It is scheduled for launch aboard a Russian Proton rocket in 2012.

ISS today

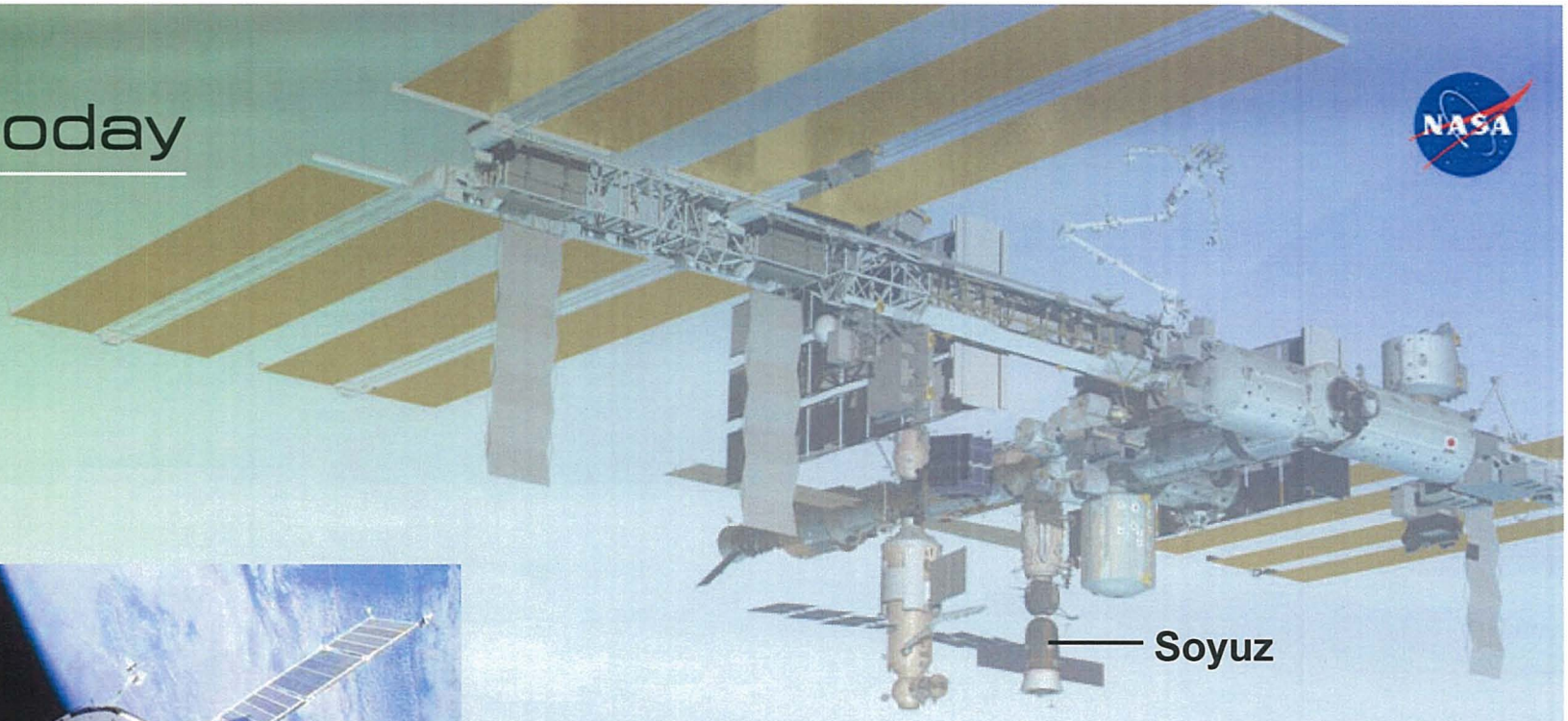
Progress

Progress approaching station

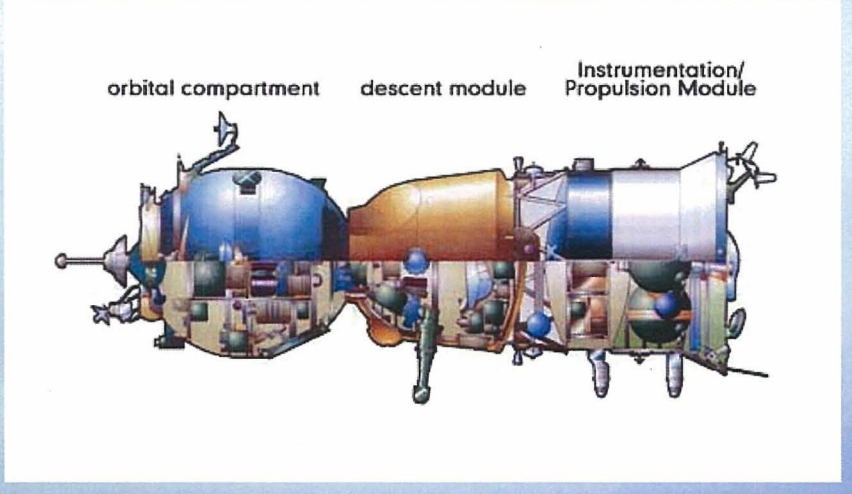
Supplies and fuel are brought to the Station by the Russian Progress vehicle, which also boosts the Station's orbit when needed.

INTERNATIONAL SPACE STATION

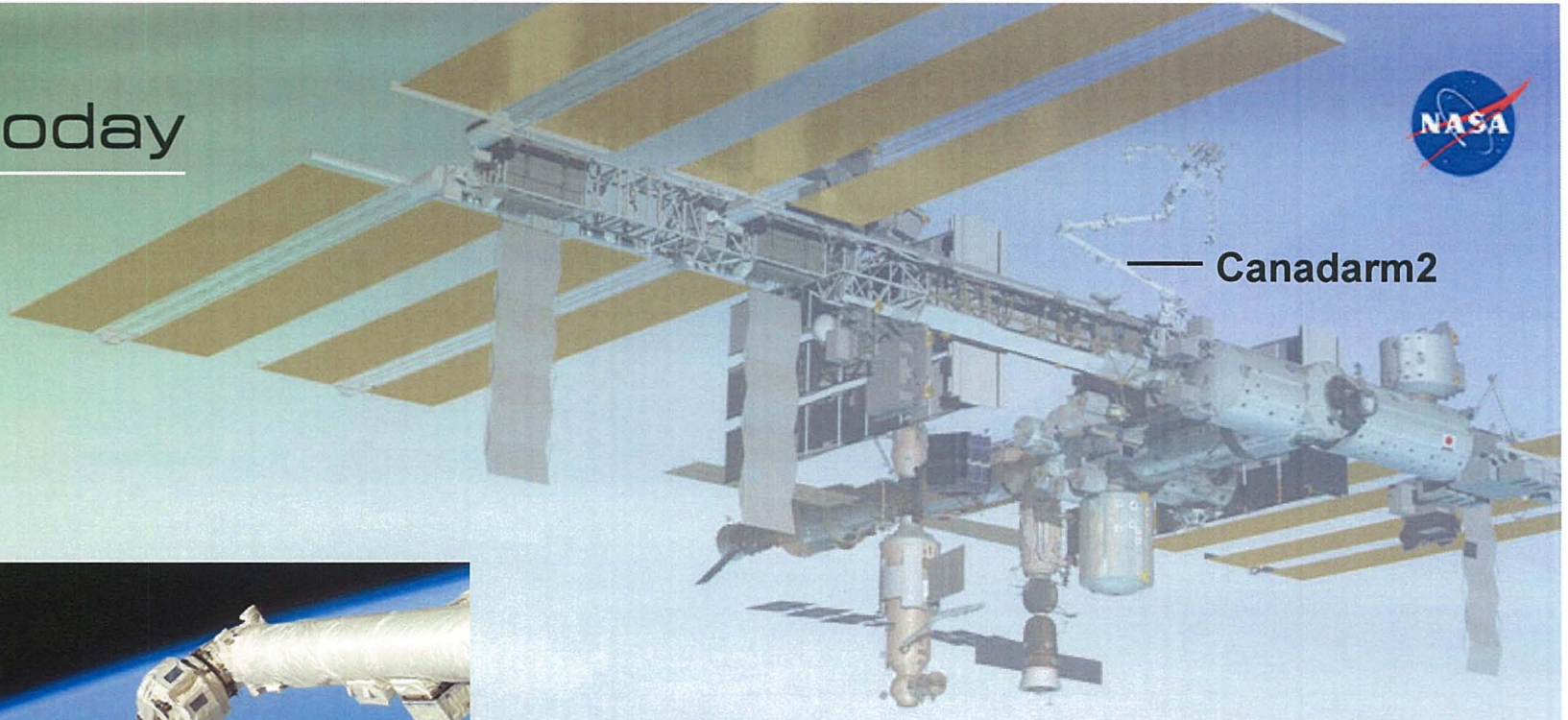
ISS today

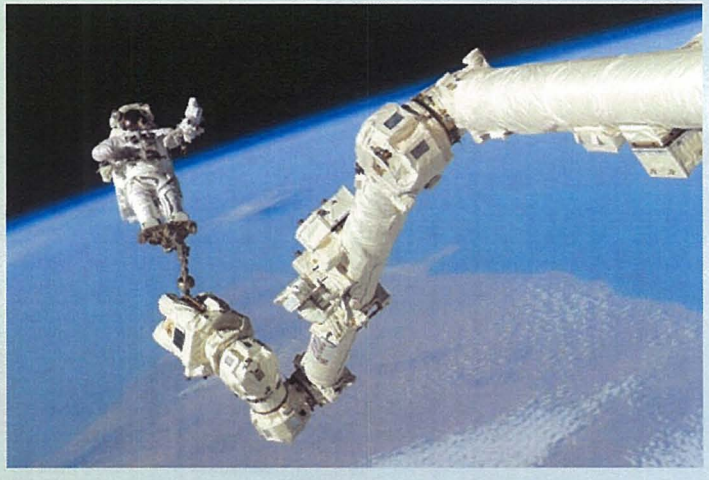


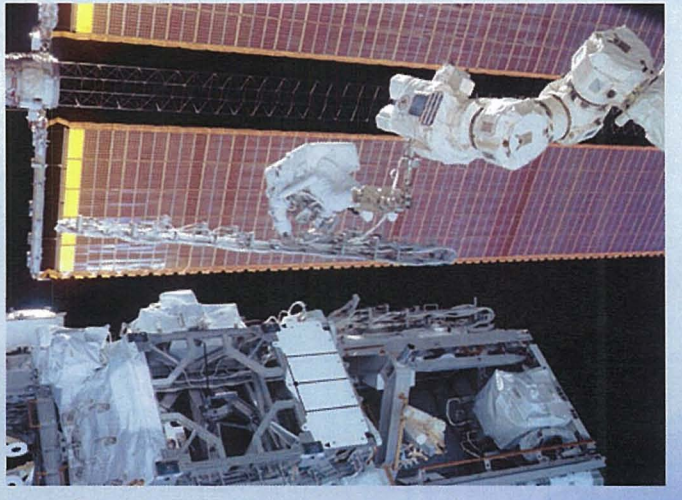
The Soyuz, replaced every six months, provides crew rotation and emergency evacuation.



ISS today

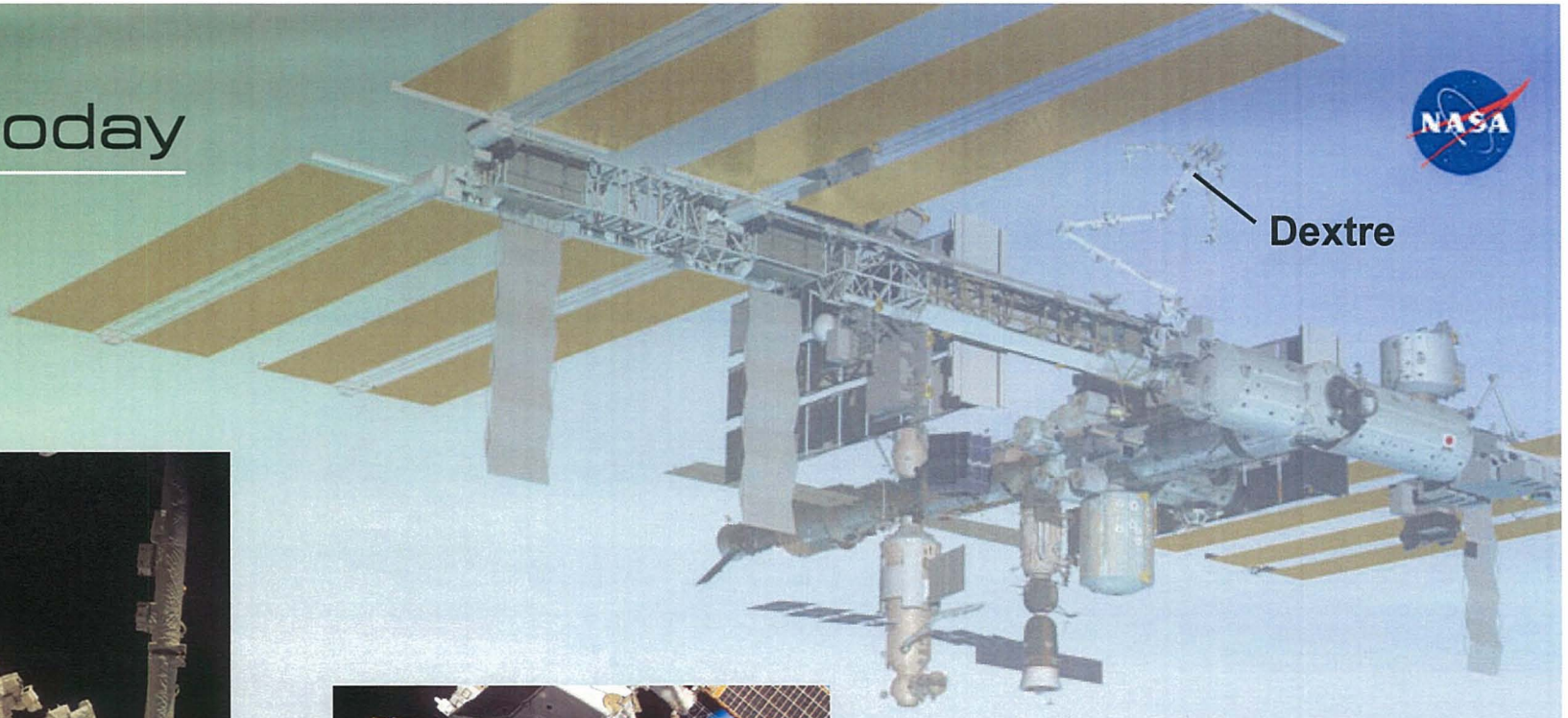


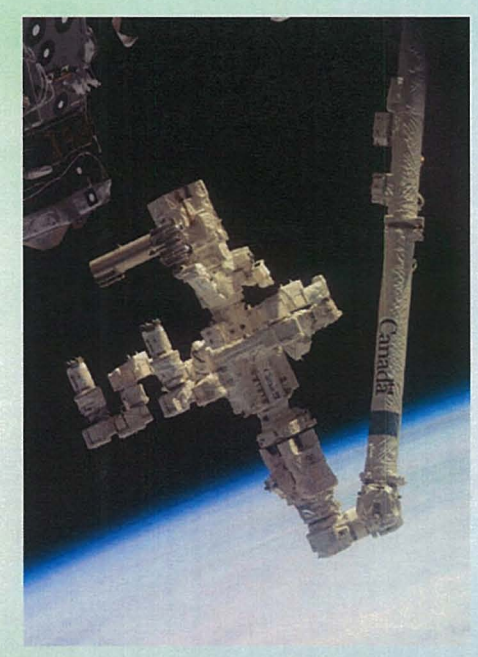




During space walks astronauts are able to maneuver and assemble the Station's massive elements with the help of the Canadian robotic arm system.

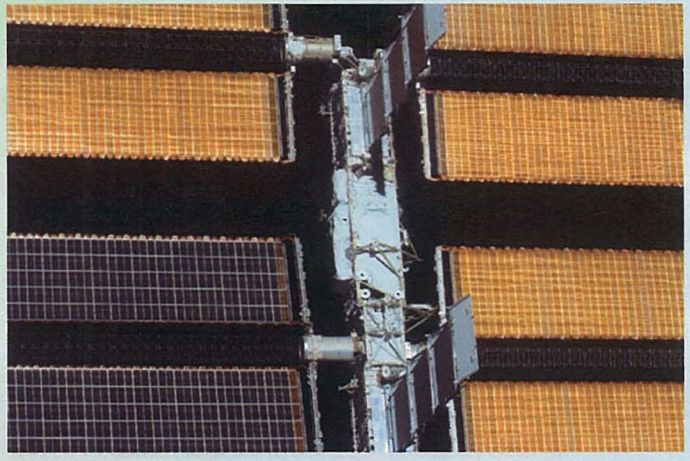
ISS today

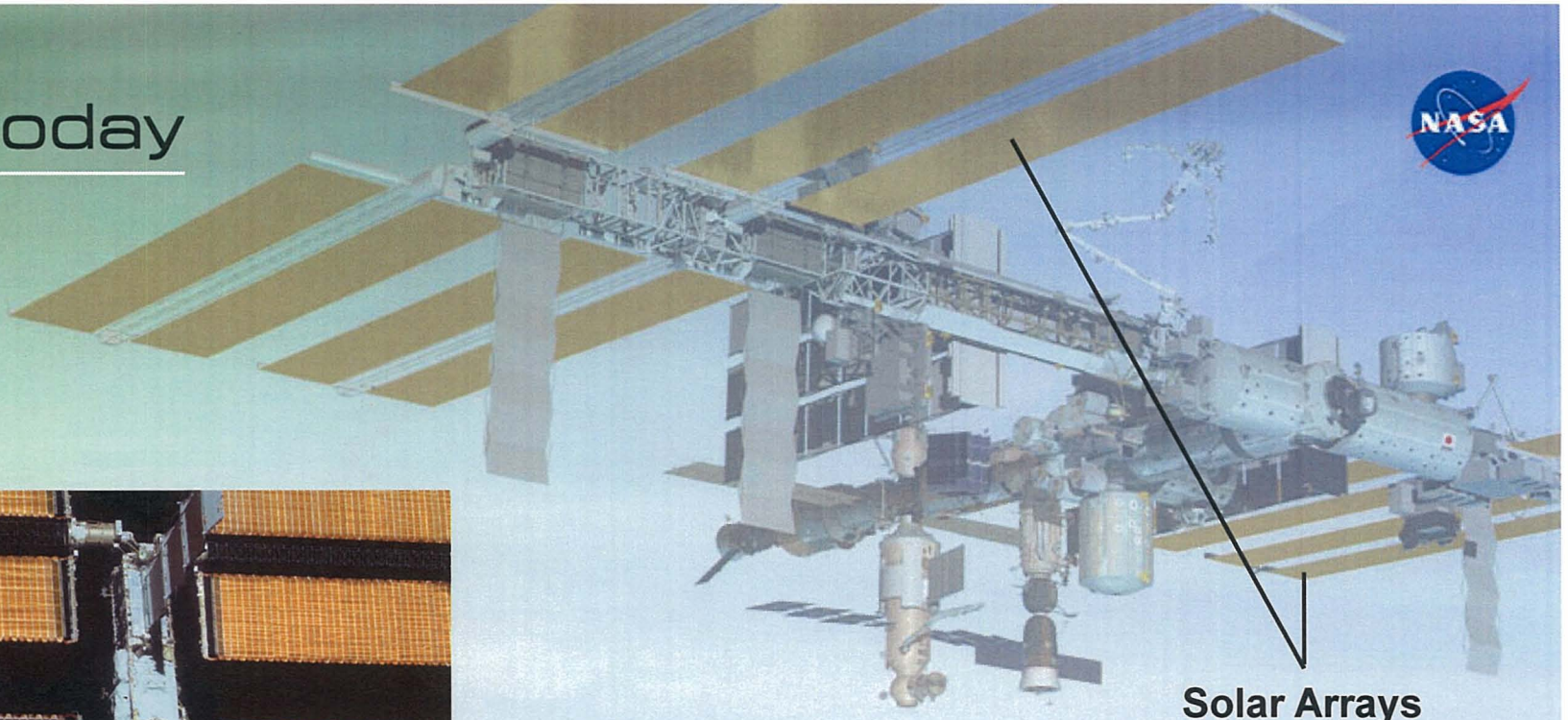




"Dextre", or the Special Purpose Dexterous Manipulator, is the final element of the Station's Mobile Servicing System. It works with the Station's robotic arm (Canadarm2) for Station maintenance and service.

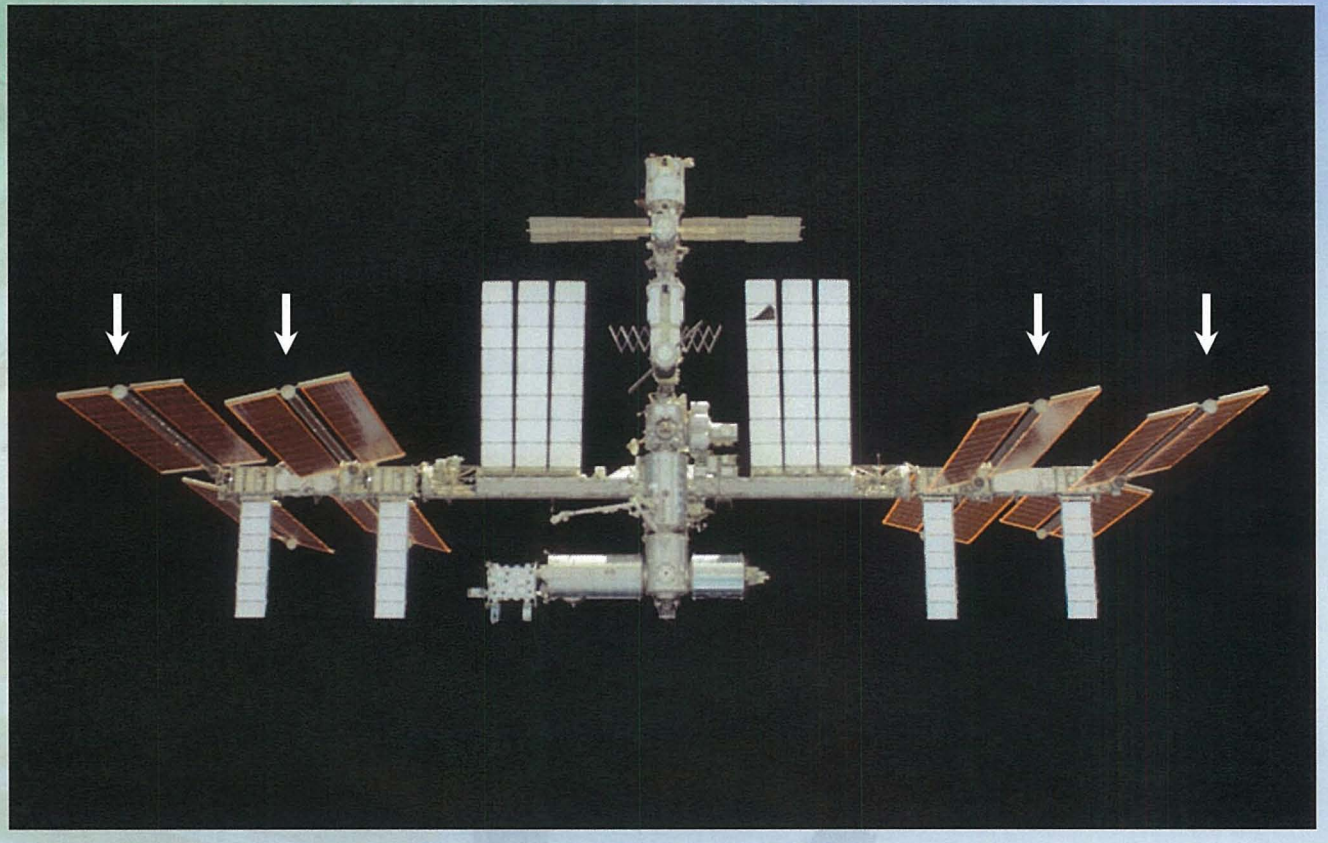
ISS today





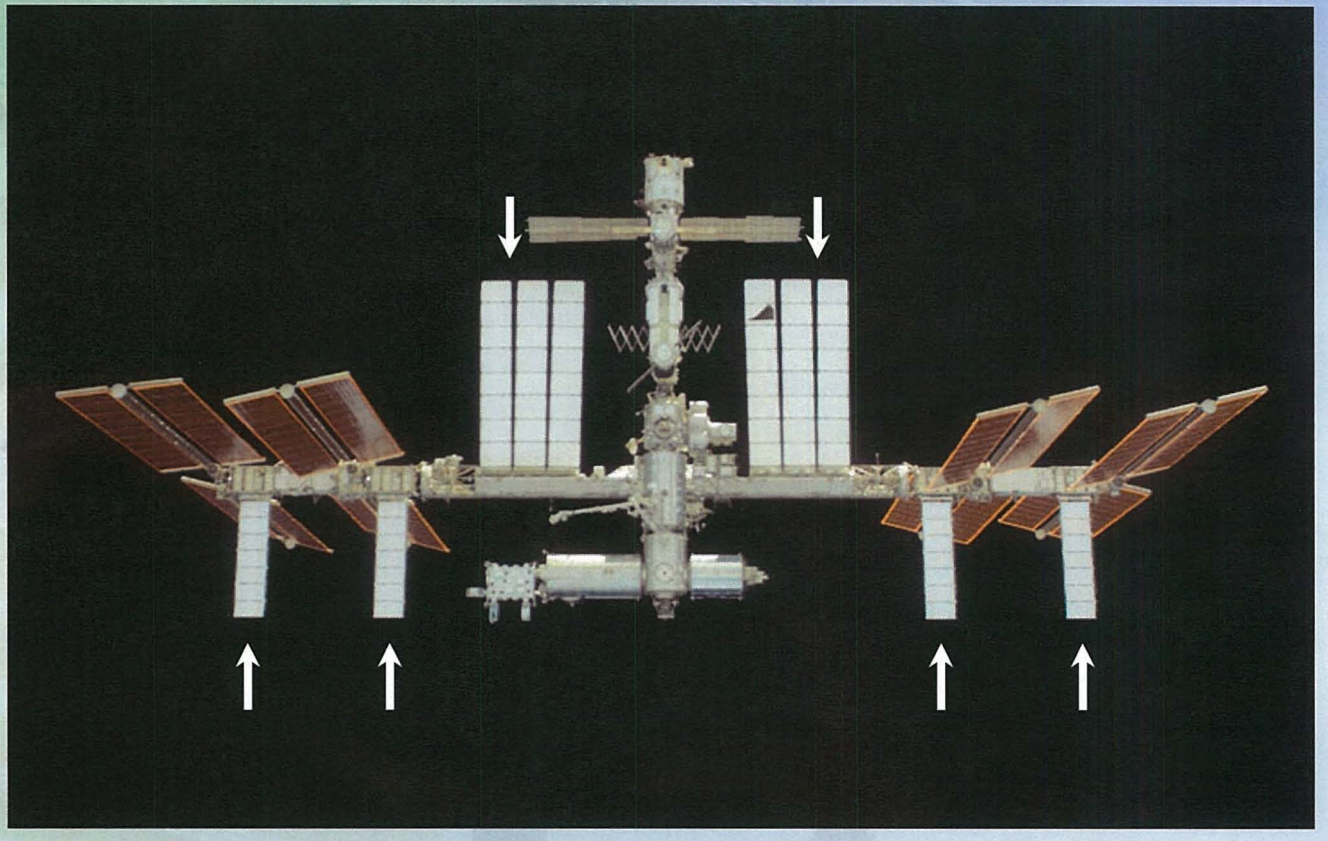
In Earth orbit, the most practical and main source of power for the Station is sunlight, converted by the Solar Array panels. During the shadow phase, the Space Station relies on banks of nickel-hydrogen rechargeable batteries to provide a continuous power source.

Electrical power subsystem



The four U.S. Solar Arrays provide up to 120 kW of power for life support, battery charging, and other power management use, enough to power 40 average homes.

Thermal control subsystem

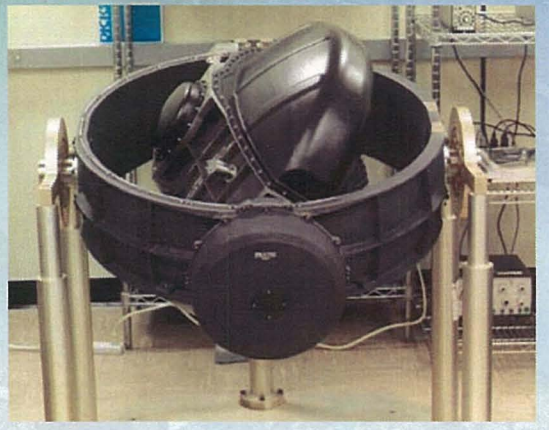


The Station's outstretched radiators are made of honey-comb aluminum panels, each providing 6 by 10 feet of ammonia tubing filled heat exchange area.

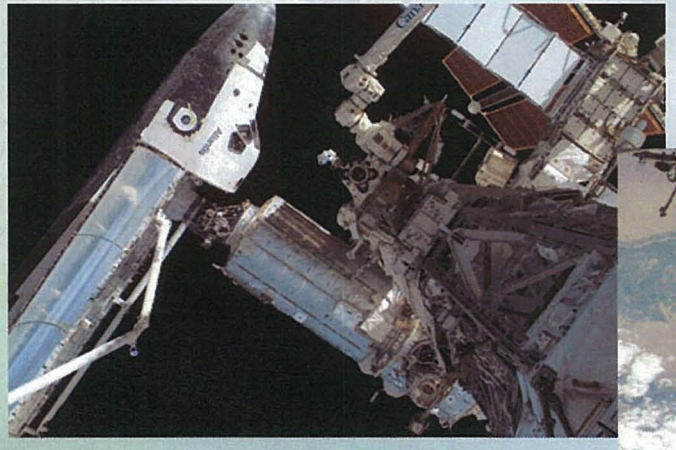
Guidance, navigation, and control

Electrical powered attitude control provided by four U.S. Control Moment Gyros.

Service Module ("Zvezda") jets can also be used.



CMGs



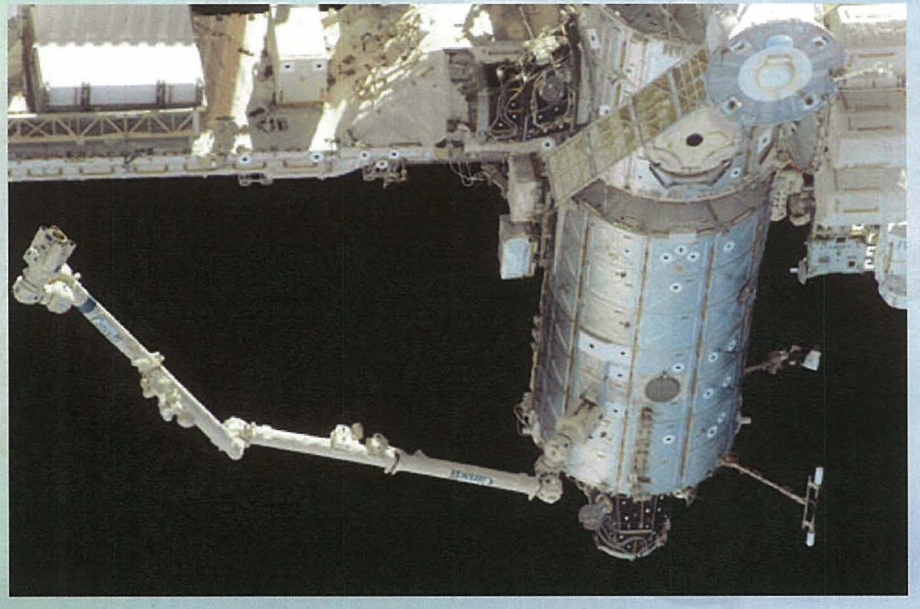
The Shuttle and the Progress are used to boost the Station when docked.

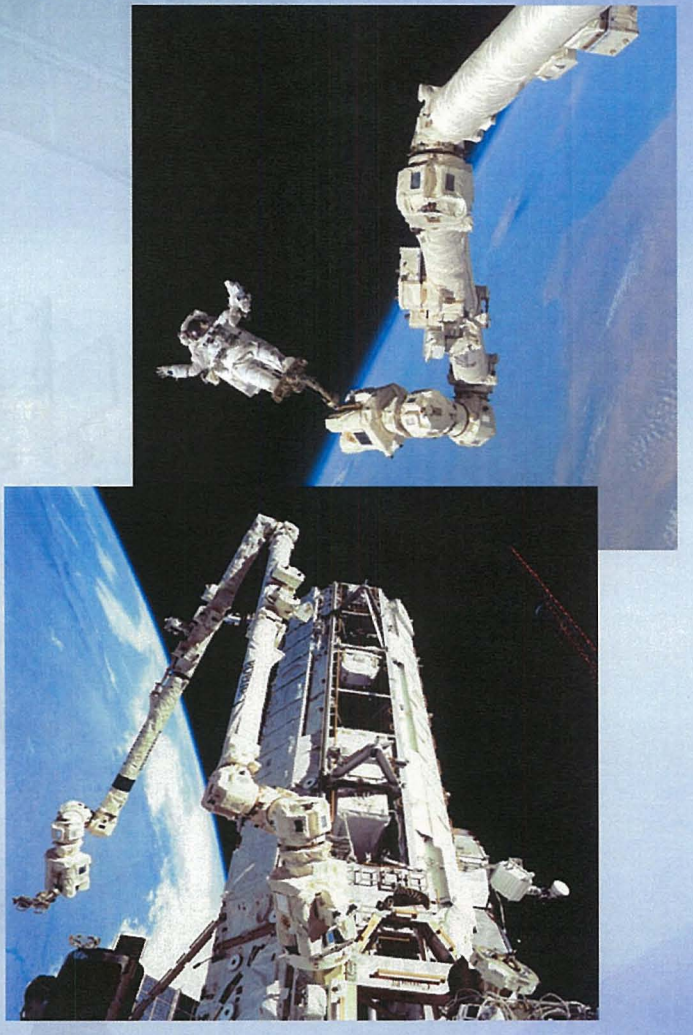
Command data and handling

The Space Station systems are controlled by over 4 million lines of software code, about half provided by the U.S. in core computers (MDMS) and laptops, and the balance from the other international partners.

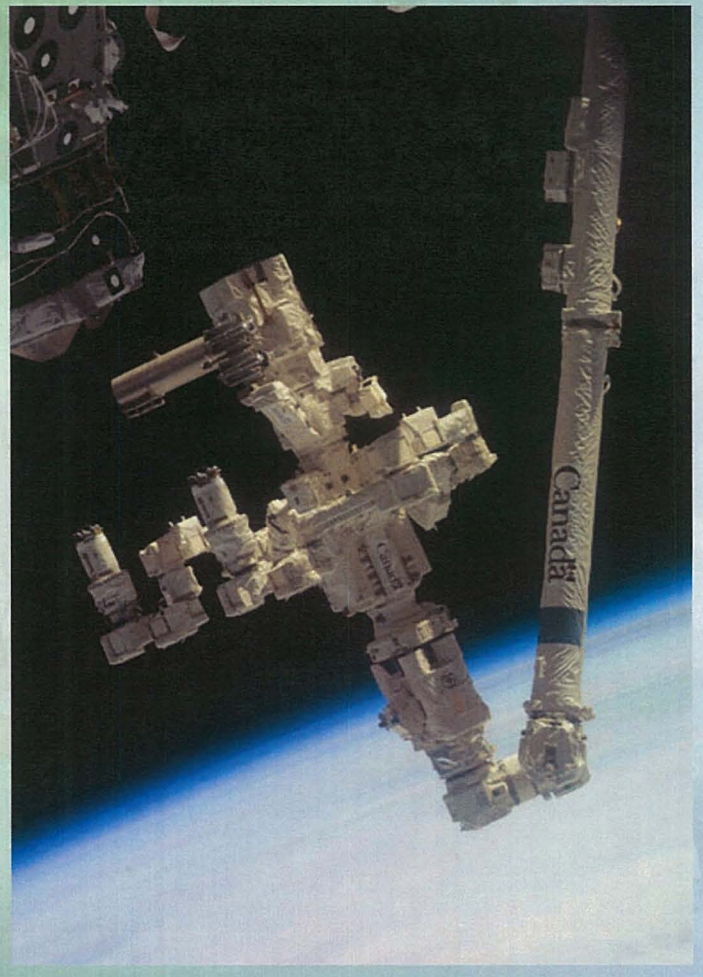
Robotics

Canadarm2 represents next-generation robotics. By flipping end-over-end between anchor points it can move around the ISS like an inchworm. With its seven joints, Canadarm2 is more maneuverable than its predecessor on the shuttle and even more agile than a human arm.

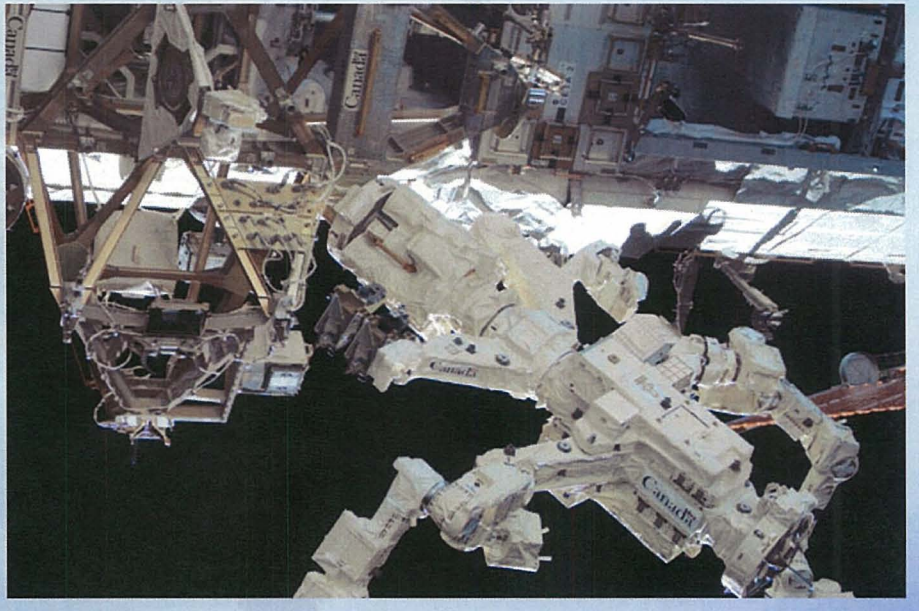




Robotics

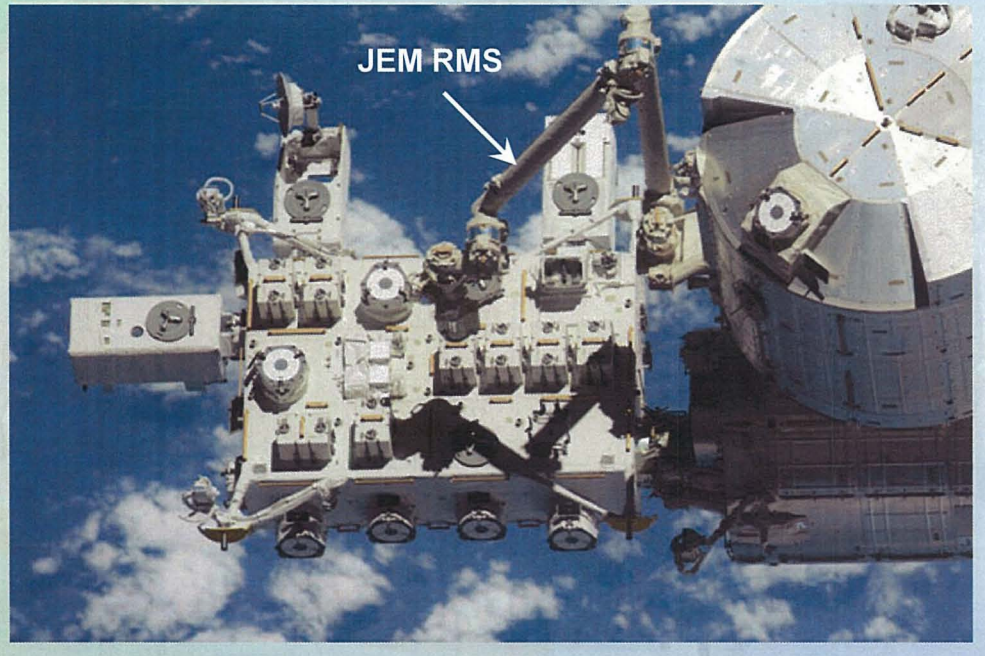


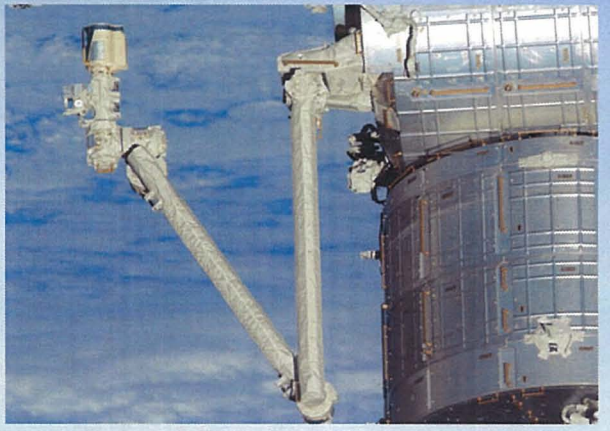
Dextre, or Special Purpose Dexterous Manipulator, is the final element of the station's Mobile Servicing System. Designed for station maintenance and service, it has two arms and four cameras and is able to work from the end of Canadarm2 or the station's Mobile Base System.

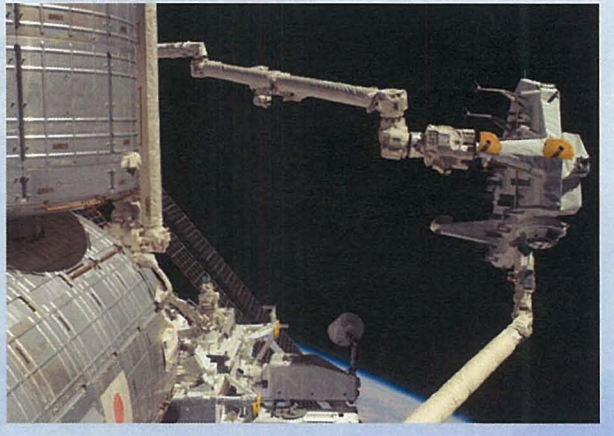


Robotics

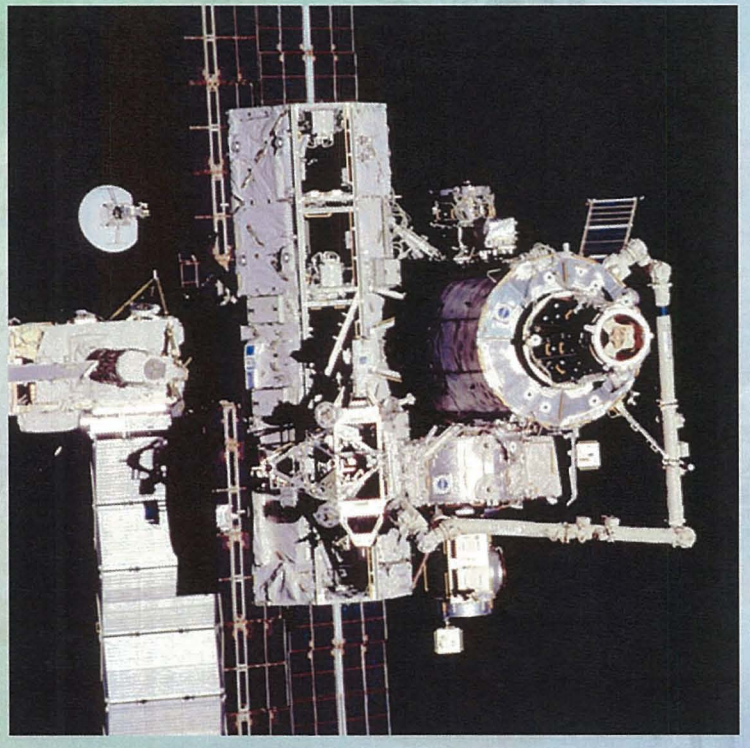
The JEM Remote Manipulator System (JEMRMS) is a robotic arm developed for supporting experiment and maintenance activities on the exposed areas of the "Kibo" science lab.



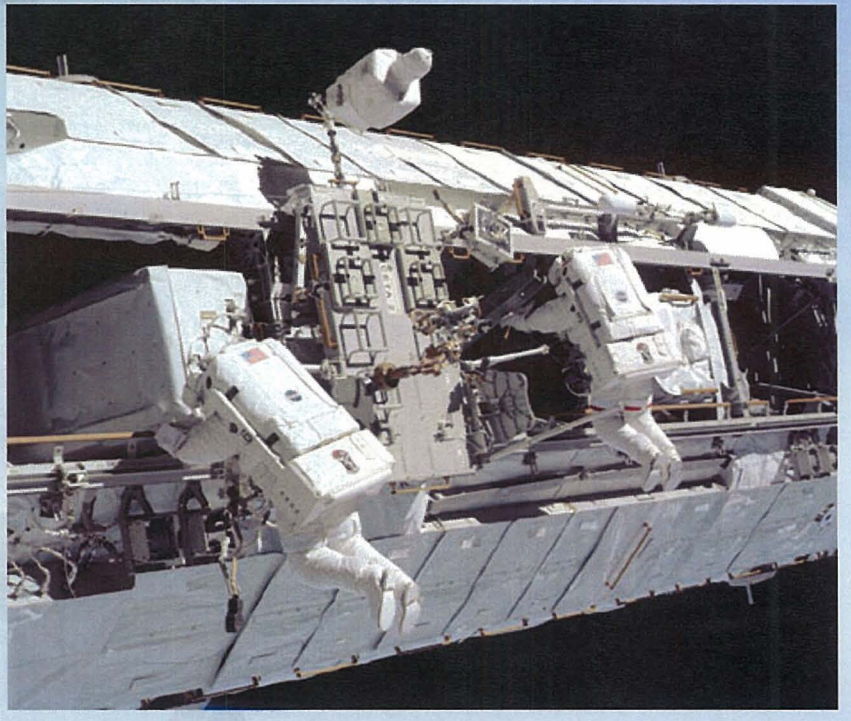




Robotics

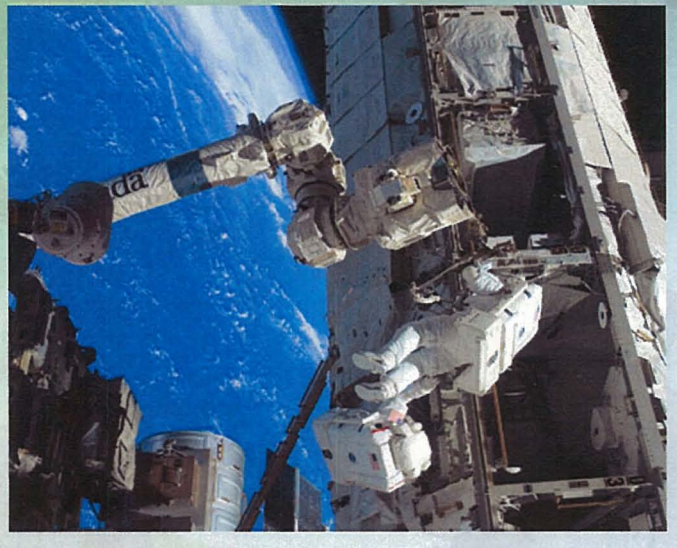


Mobile Base System

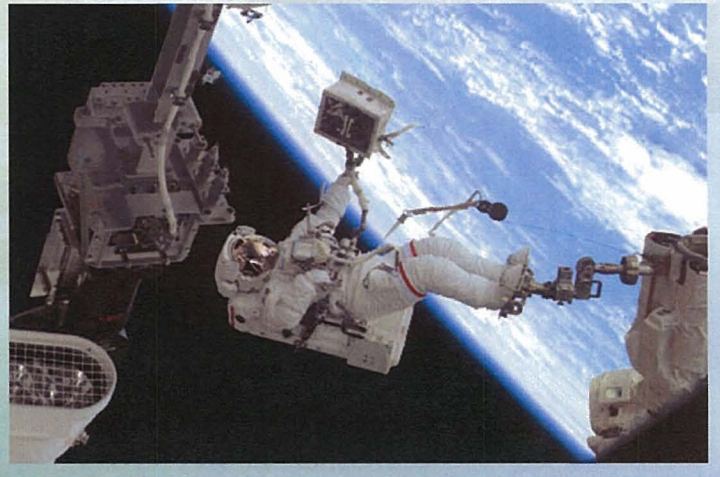


Crew Equipment and Translation Aid Cart (CETA)

Human and robotic integration

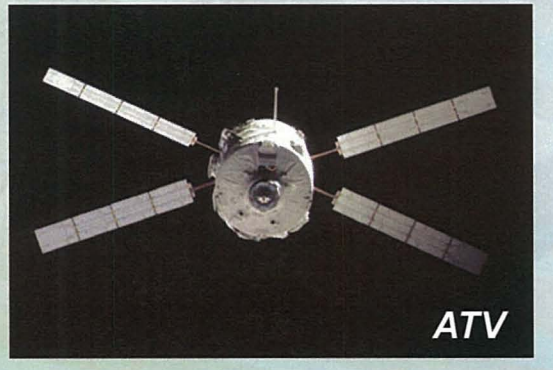


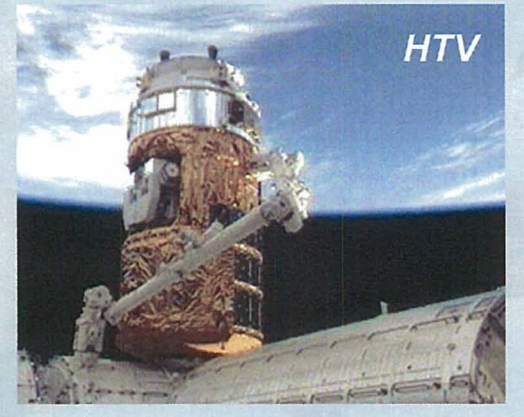
The ISS is advancing human and robotic space operations to new heights experimenting with tools and equipment in the challenging environment of space.



Additional modes of re-supply

The European Space Agency's three Italian built Multi-Purpose Logistics Modules (MPLM) - Leonardo, Rafaello, and Donatello - are brought to the Station in the shuttle's payload bay. ESA has also successfully docked and undocked their first unmanned Automated Transfer Vehicle (ATV).





Japan has also built, launched and docked the unmanned HII Transfer Vehicle (HTV), that will perform additional logistics and re-supply functions in the future.

A springboard for many futures

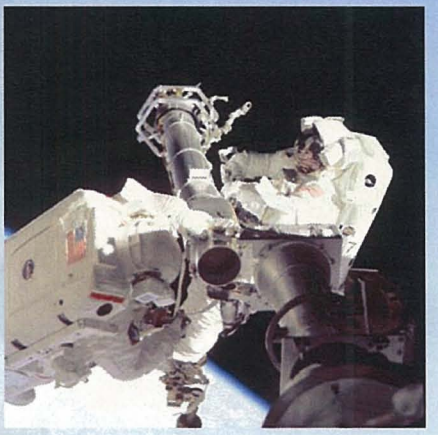
Science Leads the Way

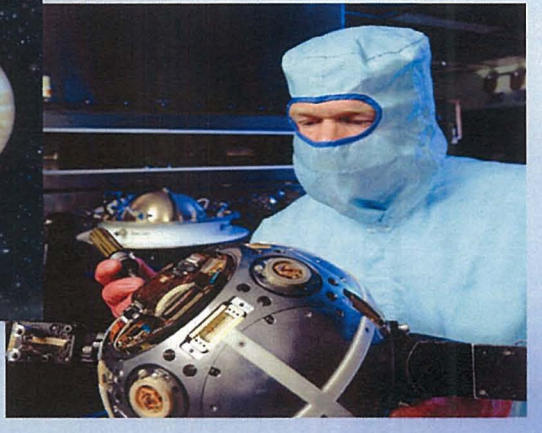
Space Engineering

Exploration of the Universe

Space Commerce test bed

Inspiring the Next Generation





INTERNATIONAL SPACE STATION

See the ISS fly over your town at:

INTERNATIONAL SPACE STATION