NASA Advisory Council
Space Operations Committee

Johnson Space Center

September 13-14, 2010

Presented to the NASA Advisory Council on October 6, 2010

Space Operations Committee

Meeting at Johnson Space Center, September 13-14, 2010

- Col. Eileen Collins (ret.), Chair
- Dr. Pat Condon, Vice Chair
  - Aerospace Consultant, former Commander of the Ogden Air Logistics Center, the Arnold Engineering Development Center, and the Air Force Armament Laboratory
- Dr. Leroy Chiao
  - Former NASA Astronaut and International Space Station Commander
- Mr. Tommy Holloway
  - Former Space Shuttle and International Space Station Program Manager
- Mr. Glynn Lunney
  - Former NASA Flight Director

Not attending:

- *Dr. John Grunsfeld*
  - *Former NASA Astronaut, Deputy Director, Space Telescope Science Institute*
- *Ms. JoAnn Morgan*
  - *Former Kennedy Space Center Associate Director, KSC Safety & Mission Assurance Director*
- *Mr. Bob Sieck*
  - *Former Space Shuttle Launch Director*

- Mr. Jacob Keaton, Executive Secretary, NASA

Summary of Activities

- Site Visits:
  - Advanced Simulators: committee members “flew” Orion Entry sim
  - Viewed Orion docking tabletop sim
  - Viewed crew training of H-II Transfer Vehicle (HTV) “grapple”
  - Viewed Autonomous Landing and Hazard Avoidance Technology (ALHAT) sim
  - Viewed Sensor Test for Orion RelNav Risk Mitigation (STORRM) for STS-134
  - Advanced Suit Laboratory
  - Robonaut 2 Facility
  - Astronaut Post-Flight Rehabilitation Facility

Summary of Activities

- Meetings with NASA Leadership:
  - Mike Coats, Johnson Space Center Director
  - Bill Gerstenmaier, Associate Administrator for Space Operations
  - Peggy Whitson, Chief, Astronaut Office
  - Mike Suffredini, International Space Station Program Manager
  - John Casper, Space Shuttle Associate Program Manager

Summary of Activities

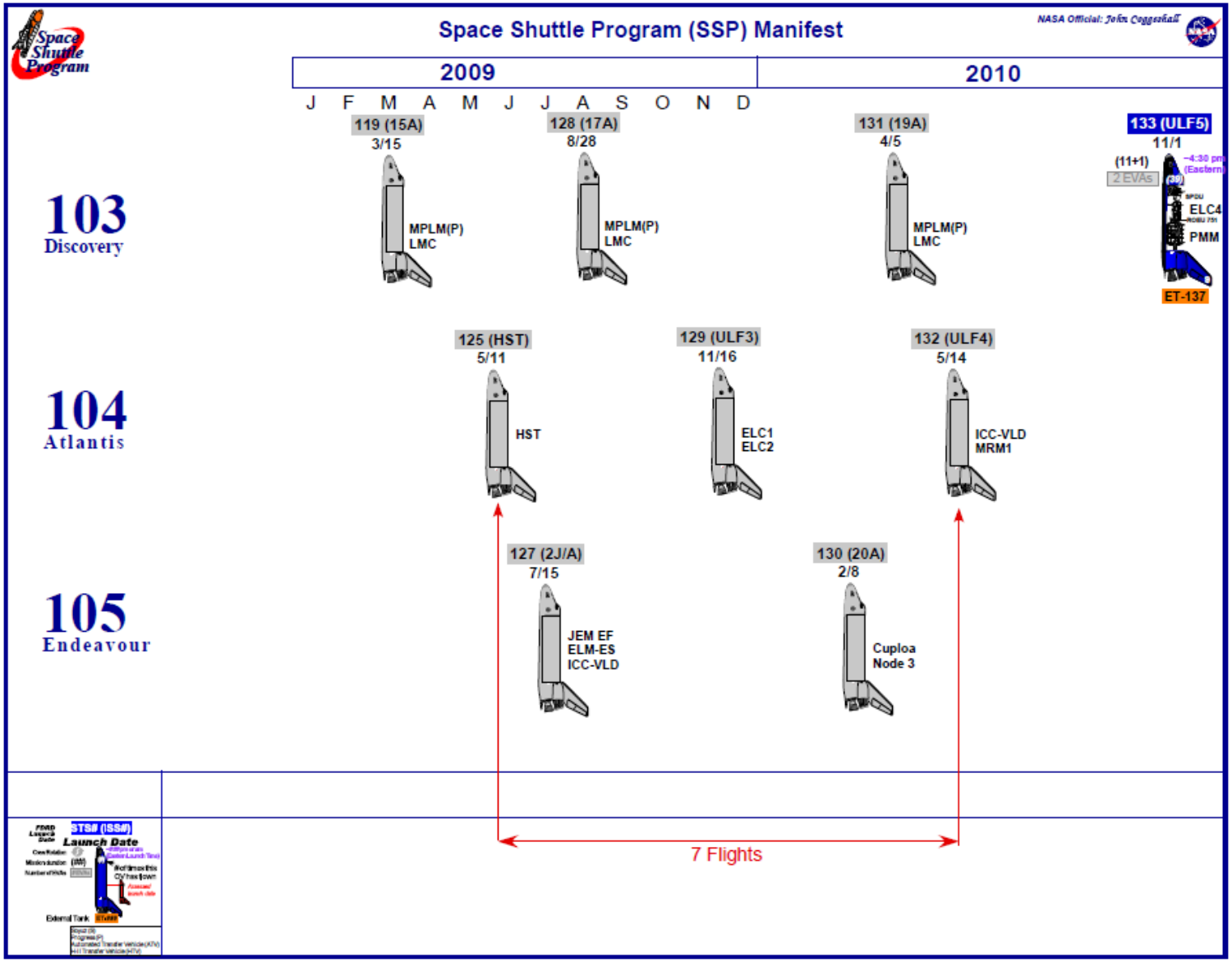
- Briefings:
  - Commercial Crew to ISS (Suffredini)
  - Commercial Vehicle Crew Design (Whitson)
  - ISS as a Future Exploration Testbed (Neumann)
  - Space Shuttle Program Update (Casper)
  - International Space Station Program Update (Suffredini)

- Joint Meeting with Commercial Space Committee

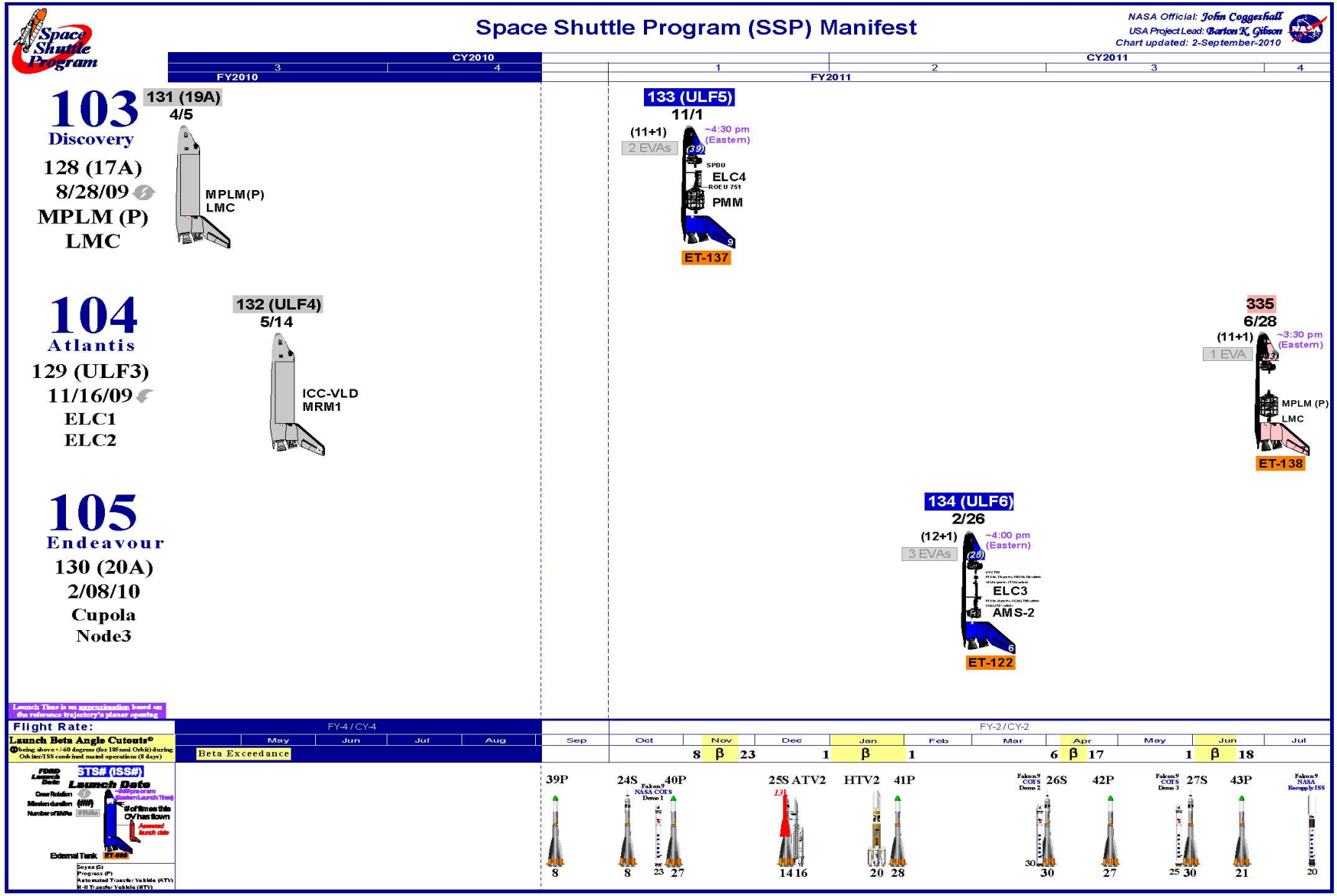
Top Issues

- Workforce at Kennedy and Johnson Space Centers
- Commercial crew:
  - Verification / Certification
  - Reliability
  - Government role in development
  - Numerous operational factors fold into design
  - FAA licensing
  - Passing NASA experience to commercial firms
- Space Shuttle: in very good shape operationally
  - Issues are shutdown, transition (to?), and end of life
- Space Station: in very good shape operationally
  - Issues are getting the most out of the station for research and future exploration

Flown Manifest: March 2009 – May 2010



Planning Manifest as of September 2, 2010



November Mission: STS-133

Launch Target:
4:40 p.m., EDT - Nov. 1, 2010

Orbiter:
Discovery

Mission Number:
STS-133
(133rd Space Shuttle flight)

Launch Window:
10 minutes

Launch Pad:
39A

Mission Duration:
11 days

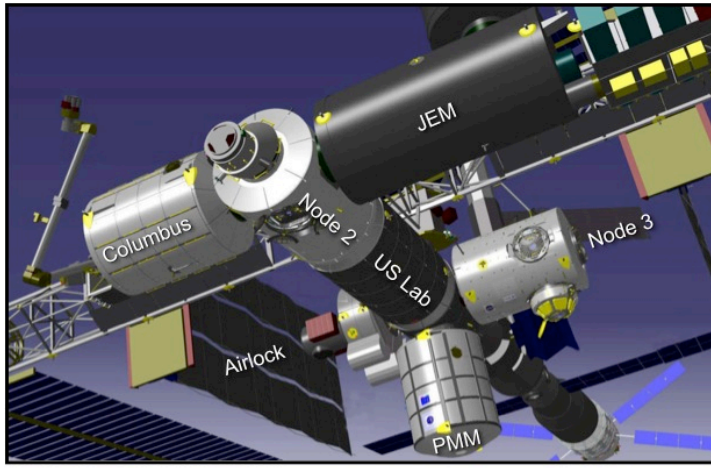
Landing Site:
KSC

Inclination/Altitude:
51.6 degrees/122 nautical mi

Primary Payload:
35th ISS flight (ULF5), EXPRESS Logistics Carrier 4 (ELC4), Permanent Multi-Purpose Module (PMM)

STS-133 Crew
Left to right

Alvin Drew
Nicole Stott
Eric Boe, Pilot
Steve Lindsey, Commander
Michael Barratt
Tim Kopra



- 35th Space Shuttle mission to the ISS.
- Permanent Multipurpose Module, the Express Logistics Carrier 4.
- Provided critical spare components to the ISS.

Upcoming Mission: STS-134

Launch Target:
4:04 p.m., EST - Feb. 26, 2011

Orbiter:
Endeavour

Mission Number:
STS-134
(134th Space Shuttle flight)

Launch Window:
10 minutes

Launch Pad:
39A

Mission Duration:
10 days

Landing Site:
KSC

Inclination/Altitude:
51.6 degrees/122 nautical mi

Primary Payload:
36th ISS flight (ULF6), EXPRESS Logistics Carrier 3 (ELC3), Alpha Magnetic Spectrometer (AMS)

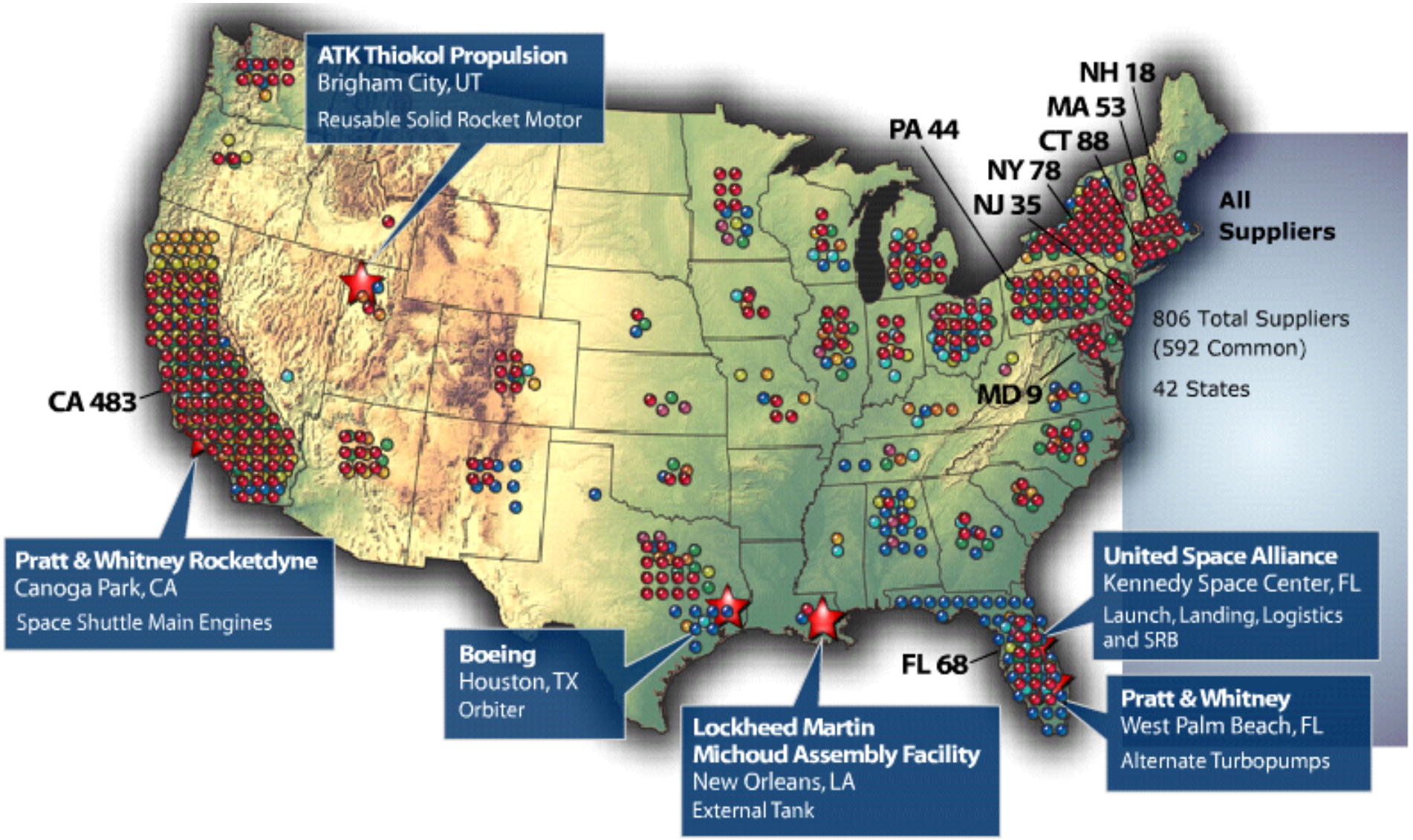
STS-134 Crew
(Clockwise starting bottom center)

Mark Kelly, Commander
Gregory H. Johnson, Pilot
Michael Fincke
Greg Chamitoff
Andrew Feustel
Roberto Vittori, European Space Agency

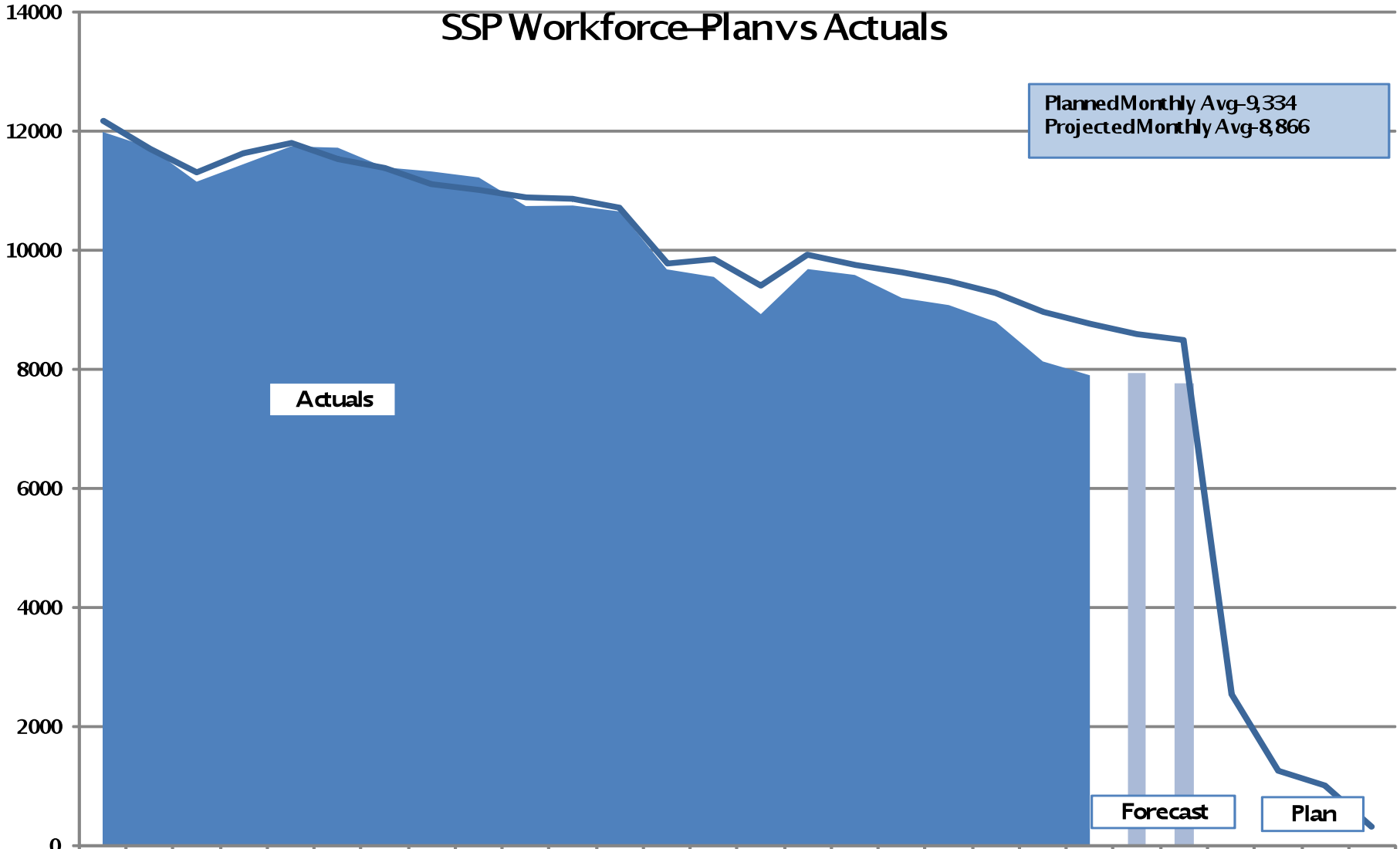
AMS

- 36th Space Shuttle mission to the ISS.
- Endeavour will deliver the AMS plus spare parts including two S-band communications antennas.
- High-pressure gas tank, additional spare parts for Dextre, and micrometeoroid debris shields

Space Shuttle Program Major Suppliers



Space Shuttle Contractor Workforce



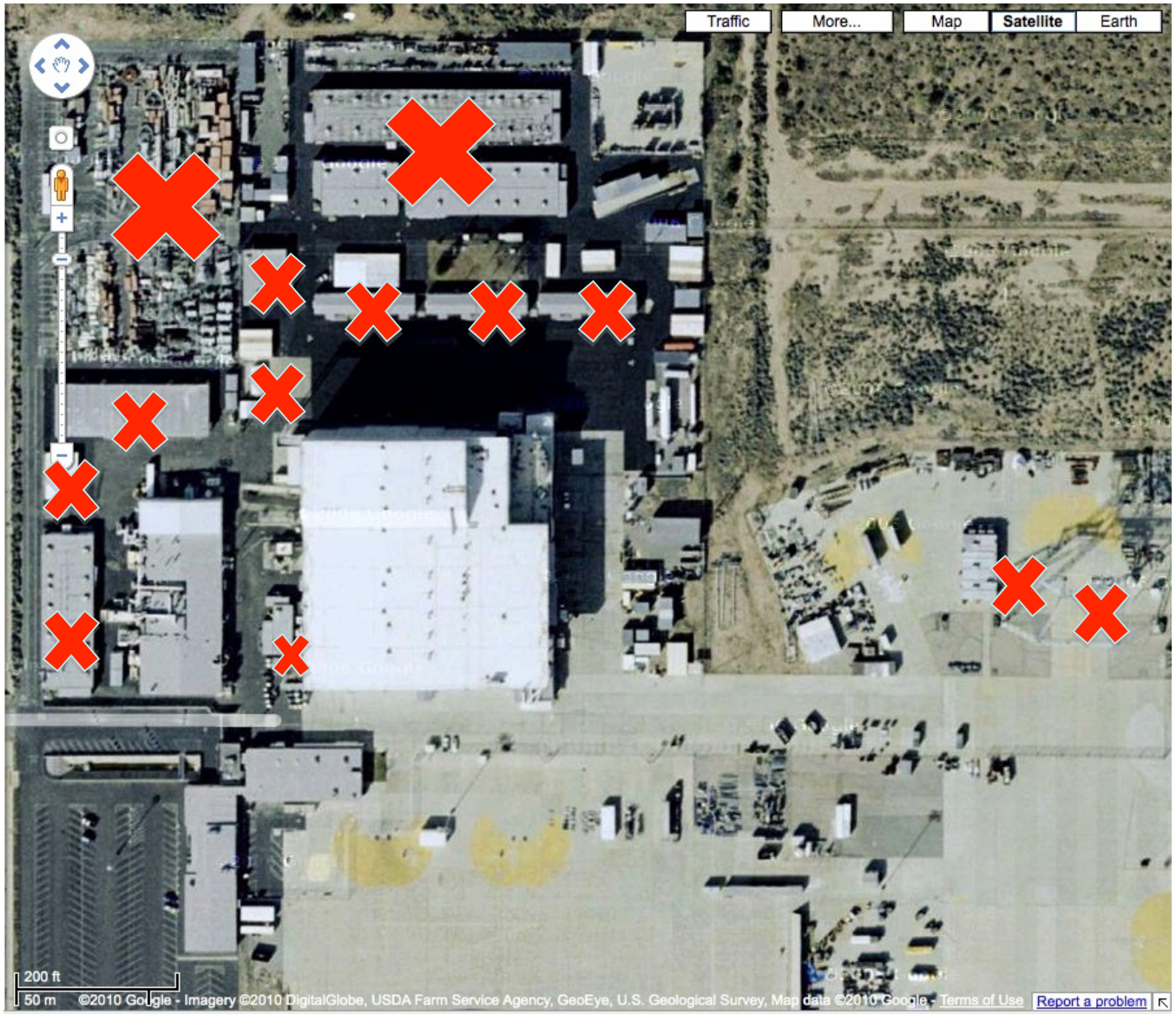
	O 08	N 08	D 08	J 09	F 09	M 09	A 09	M 09	J 09	J 09	A 09	S 09	O 09	N 09	D 09	J 10	F 10	M 10	A 10	M 10	J 10	J 10	A 10	S 10	O 10	N 10	D 10	J 11
SSP Actuals	12001	11741	11166	11461	11758	11737	11406	11336	11237	10756	10766	10665	9693	9566	8942	9698	9599	9213	9092	8811	8146	7914						
SSP Forecast																							7941	7775				
SSP Plan	12183	11703	11308	11640	11816	11545	11387	11116	11008	10888	10875	10726	9786	9851	9404	9938	9768	9643	9477	9297	8967	8771	8596	8512	2551	1273	1025	332

Space Shuttle Transition and Retirement (T&R)

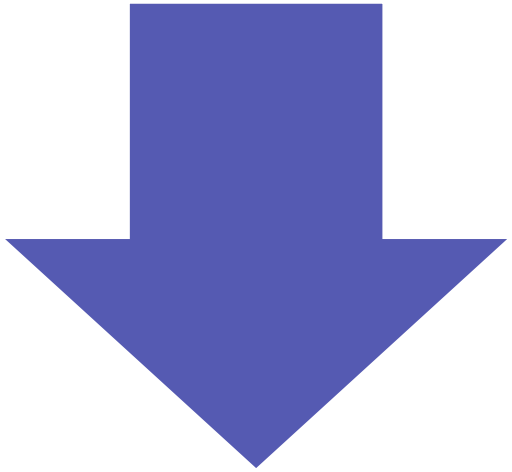
- **SSP T&R is funded through FY 2012 with an aggressive but achievable plan**
  - Will complete the flight manifest by June 2011.
  - All appears to be on plan and progressing well, considering the changes being experienced by the workforce
  - Constellation (Cx) transition and cancellation results in additional T&R costs
  - Orbiters to be safed and ready for transport by the end of FY 2012
  - Historic artifacts identified and screened with museums/educational institutions for placement
  - Kennedy Space Center (KSC) major facility transfers in work to support 21st Century Launch Complex and future Agency programmatic use.
  - Michoud Assembly Facility (MAF) to be maintained at a Customer Tenant Ready (CTR) level through FY 2011 while future Agency requirements are determined.

Palmdale Aerial – Before T&R Commenced

Palmdale Aerial – After T&R Completed



What Is Impacting Morale

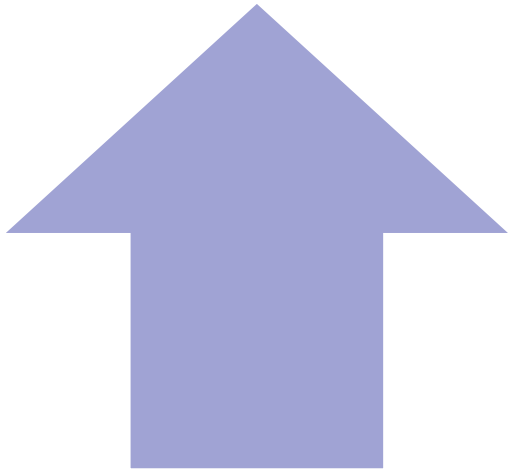


Negatives

- Emotional impacts of end of Program
- Loss of key contactor employees
- Concern about future work—good jobs gone, not enough to do, interesting work outside the Agency
- Uncertainty of future mission of the Agency

Positives

- Meaningful Work in the Shuttle Program
- Commitment to SSP and NASA
- Ability to make a difference in SSP
- Assurances by NASA about interesting future work



Things We're Hearing…

Confidence to support the SSP through the end of the Program

Supervisory Survey

Survey Date	Civil Servant			Contractor		
	Green %	Yellow%	Red %	Green %	Yellow%	Red %
August 2008	64	32	4	43	40	14
February 2009	55	39	4	42	47	3
December 2009	71	24	4	46	46	4
May 2010	90	7	1	55	31	4

I am likely to stay with SSP through program retirement.

Employee Survey

	SD	Disagree	NA/D	Agree	SA
2006	7.5%	10.7%	16.1%	34.5%	31.2%
2007	7.2%	7.1%	18.3%	37%	29.5%
2008	2.5%	4.8%	16.8%	38.0%	33.7%
2009	1.2%	3.0%	11.6%	35.2%	47.9%
2010	2.1%	3.0%	12.9%	29.9%	50.1%

Current search for jobs outside the SSP

68% aren't looking right now (69.2 % '09); 8.8% are actively looking (5% in '09 and 10.8% in '06)

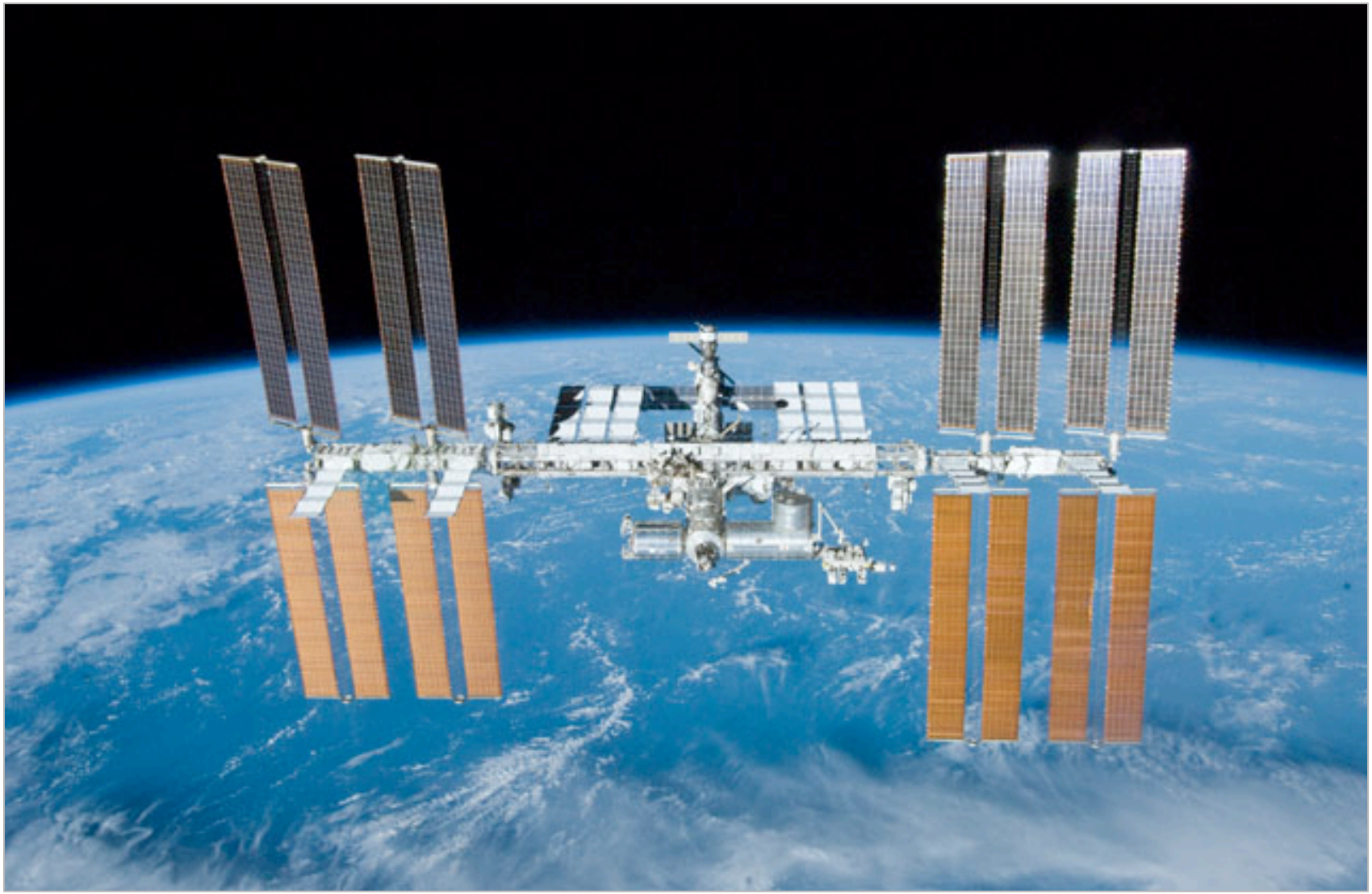
Worried about type of work available after Shuttle work ends.

SA/A: 2006 (36.4%) 2007(42.7%) 2008(45.2%) 2009(52.5%) 2010 (62.5%)

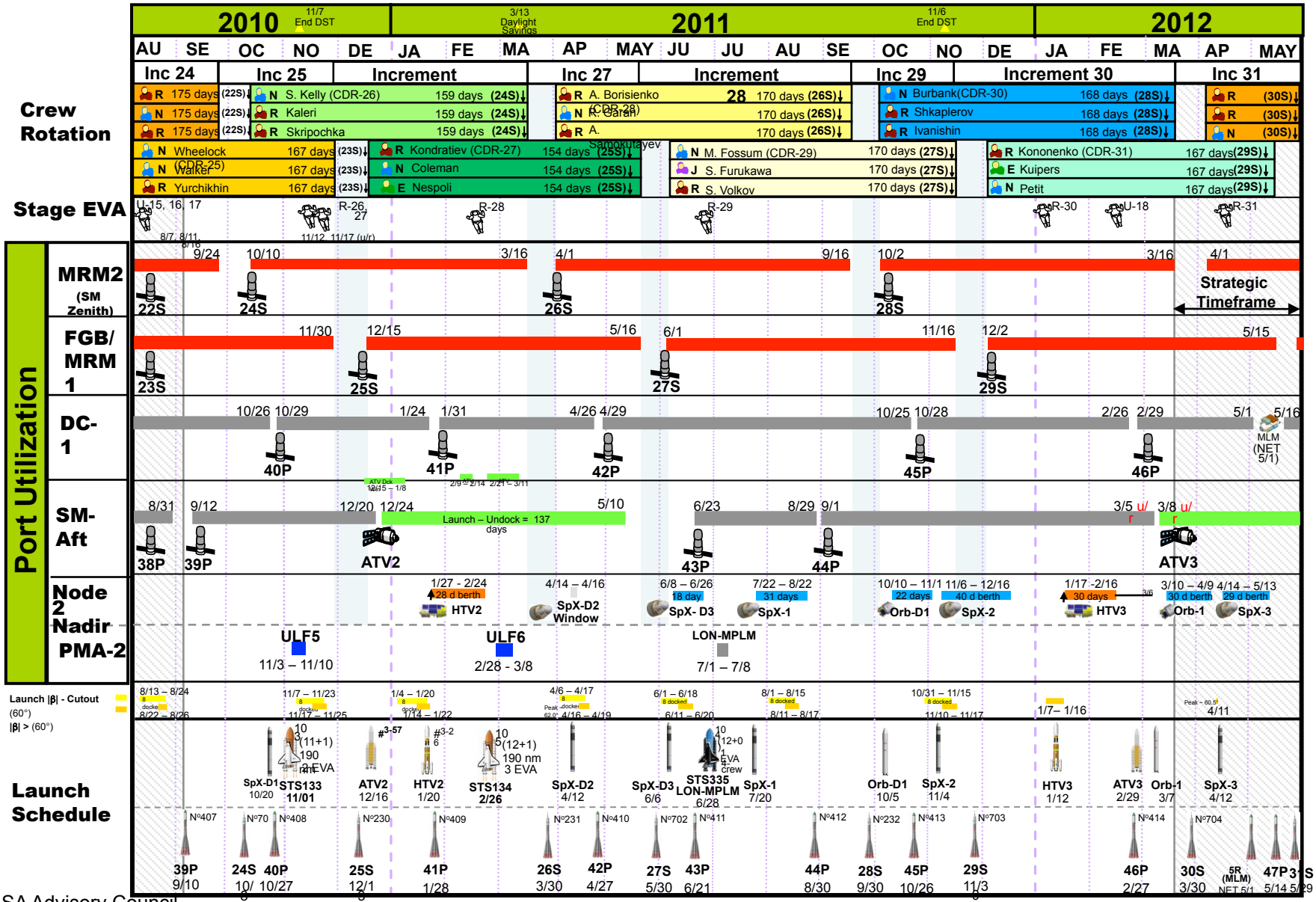
Overall Shuttle Program Summary

- #1 goal is to fly the remaining missions safely and successfully
- Top Program Risks are identified and worked as a high priority
- Retention of critical skills is a major program emphasis
- Program resources are allocated to mitigate, control, and reduce Top Program Risks
- T&R issues have been worked for several years by all managers

International Space Station on May 23, 2010



Crew Utilization and Port Rotation Graphic



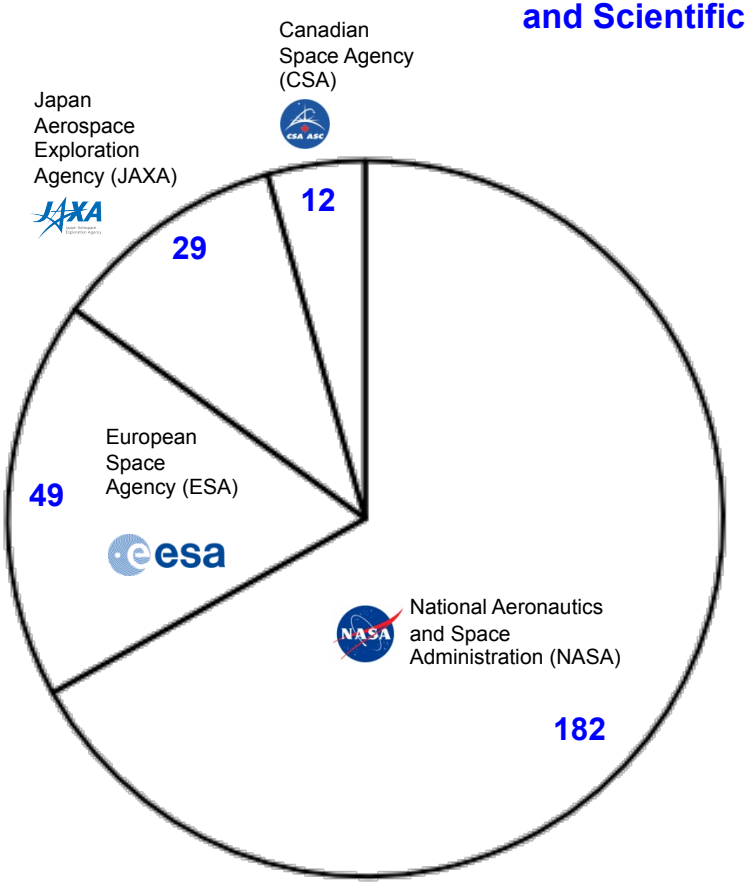
Expedition 24 Research Program

- Plans for Expedition 24 include operation of 127 integrated experiments in biology and biotechnology, Earth and space science, educational activities, human research, physical and materials sciences and technology.
- Experiments on this Expedition will support the work of more than 400 scientists
- Four new facilities have been delivered to the ISS
  - EXpedite the PRocessing of Experiments to Space Station Rack 7 *(*EXPRESS Rack 7)
  - Muscle Atrophy Research and Exercise System (MARES)
  - Minus Eighty-Degree Laboratory Freezer for ISS – 3 (MELFI-3)
  - Window Observational Research Facility (WORF)
- The ISS currently has 23 research facilities
  - Advanced Biological Research System (ABRS), Biological Experiment Laboratory (BioLab)
  - Combustion Integrated Rack (CIR), Fluids Integrated Rack (FIR), Materials Science Research Rack-1 (MSRR-1), Fluid Science Laboratory (FSL)
  - Two Human Research Facility Racks (ultrasound, refrigerated centrifuge, pulmonary function system, etc.
  - Six EXPRESS Racks (provide power, communications and vibration isolation for experiments)
  - European Modular Cultivation System (EMCS) – located within EXPRESS Rack 3A
  - Microgravity Sciences Glovebox (MSG)
  - Two Minus Eighty degree Laboratory Freezer for the International Space Station (MELFI)
  - European Drawer Rack (EDR), European Physiology Modules (EPM), European Transportation Carrier
  - Sun Monitoring on the External Payload Facility of Columbus (Solar)
  - Ryutai Experiment Rack (Ryutai), Saibo Experiment Rack (Saibo)

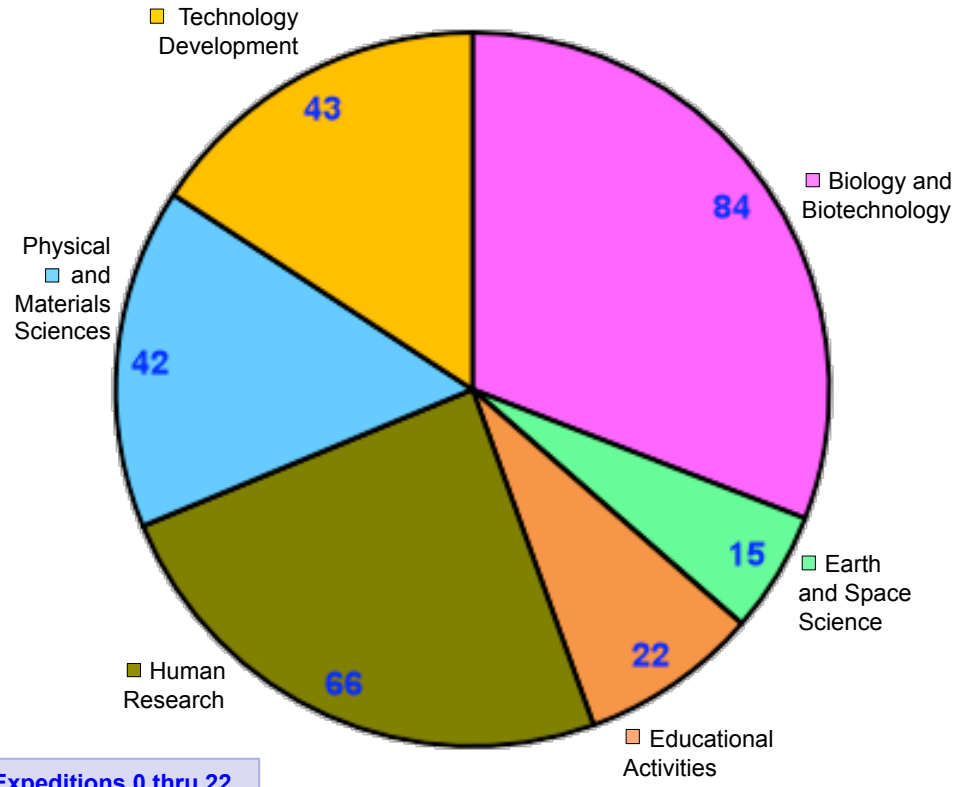
ISS Research Accommodations Status (History)

16 July 2010 (Data through 30 June 2010)

Number of New USOS Research Investigations Operated in Expeditions 0 through 22 by International Partner and Scientific Discipline Category



By International Partner



By Scientific Discipline Category

Cumulative for Expeditions 0 thru 22
272 New USOS Investigations
182 NASA, 90 Int'l Partner
26 Nat'l Lab, 153 Completed
> 985 Scientists

24 Soyuz/Expedition 25 Launch

Vehicle:	24 Soyuz, TMA-20
Launch:	Oct 8, 2010
Docking:	Oct 10, 2010
Undock/Landing:	March 16, 2011

Alexander Kaleri
Soyuz Commander/ISS Flight Engineer

Scott Kelly
ISS Flight Engineer/Exp 26 Commander

Oleg Skripochka
ISS Flight Engineer

23 Soyuz/Expedition 24 crew launched June 15, 2010
Douglas Wheelock Expedition 25 Commander
Shannon Walker ISS Flight Engineer
Fyodor Yurchikhin Soyuz Commander/ISS Flight Engineer

ISS Operational Issues

- Cooling Pump Module Failure on Aug 1, 2010
  - Pump removed and replaced during 3 EVAs
  - Outstanding, textbook job by the ISS Program
- Water Processor Assembly
- Oxygen Generator Assembly
- Carbon Dioxide Removal Assembly
- Top Program Risk: micrometeroid/orbital debris strikes

ISS as an Exploration Testbed

- “Are we using the ISS to help prepare us for future deep space exploration, and if so, how is it being done?”
- We received this briefing at the suggestion of the Exploration Committee
- Currently, there is a rich program of microgravity research: biology and biotechnology, Earth and space science, human research, physical and materials sciences and technology demonstrations on ISS (see chart 21)
- Decadal Survey is being done at the request of NASA for life and physical sciences
- Answer to above question is “Yes”
- No recommendations at this time; will continue discussions with Exploration Committee

Commercial Crew: Challenges

- Verification / Certification
  - Verification of requirements
  - Certification of vehicle
  - It is not clear how this will be done
  - Recommendation
- Government role in development
  - Can't use Soyuz as model; it had extensive flight history when NASA decided to launch its crews
  - We are not just purchasing services, we are developing the vehicle simultaneously
- Numerous operational factors fold into design
- FAA licensing
  - Discussed with NAC Commercial Space Committee and NASA management
  - Committee not able to make a conclusive comment without further study
  - Questions remain on how all will proceed (examples: redundancy, AF Range involvement, etc)
- Passing NASA experience to commercial firms
  - Recommendation

Recommendation: Verification and Certification of Commercial Crew Spacecraft

- NASA should immediately establish a strategy, plan and a team for defining and obtaining objective data which would indicate that a commercial vehicle is adequately verified, certified and tested to meet requirements. This strategy and plan should be part of the solicitation package. The plan should identify the analytical and test data, including flight test required, and NASA's involvement in the development activity to enable informed participation in reviews to ascertain that the requirements have been met. The NAC also suggests that part of the strategy should be a small technical team(s) with representatives from all critical disciplines, including flight crew personnel, to following the development of the vehicle and operations development. These teams should be limited in size and operate under guidelines defined in "the plan". These team(s) should cover all the bases, and should be staffed with specific named participants.

Rationale: At the present time NASA has not finalized a plan for insuring that the commercial crew vehicle meets or exceeds safety requirements and has an adequate probability of mission success. The current debate on "oversight versus insight" is of limited value in resolving this issue. Small teams would give the commercial provider easier access to the resources at NASA Centers and would allow trusted relationships to develop between the partners. Additionally, it is important that the flight crew members be involved from the very beginning. The on-board flight crew should know the history of the design decisions, the capabilities of hardware/software, and all options, should a malfunction/emergency develop in flight. All operational personnel are essential in the design process, and can provide valuable, creative, "how to do it better" input. Assuming at least two winners of the initial competition, NASA will need to decide if it will firewall the respective NASA review teams to avoid cross-feed, or use one team to emphasize consistency.

Recommendation: Sharing NASA know-how with commercial developers

- The NAC recommends that the impressive NASA capabilities and background available at the Human Spaceflight Centers be offered to the bidders of the commercial crew vehicle. A mechanism can be set up to share this know-how in the most efficient and useful way, to expedite development and safe operation of commercial spacecraft.

Rationale: NASA's personnel and facilities (launch pads, mission control, training) have developed to an efficient peak, over decades of human spaceflight experience. This includes: program management, flight rule development, procedure writing, spaceflight resource management, simulations, safety procedures, risk management, among others. The Council believes a strong NASA-commercial relationship is needed for the expeditious development of a human-rated launch system. There is much to be gained by studying NASA's experiences and lessons learned, especially from major accidents, malfunctions, and close calls. This includes operations, design and development.

Commercial Crew: Challenges

- Operational impacts of adding additional visiting vehicles to ISS beyond what is required to support research mission:
  - Increased ISS propellant usage and subsequent resupply (40,000kg/yr, $6-13 M/yr)
  - Power usage and balance reduces or terminates payload activity
  - Micro-g environment is affected (docking and maneuvering)
- High reliability needed to insure uninterrupted ISS mission, and prevent de-crewing of US segment

Commercial Crew: Astronaut Preferences

- No “black zones” on Ascent and Aborts (currently not in human rating requirements)
- Wear pressure suit on ascent (currently not in human rating requirements)
- Prefer “rental car” vs “taxi” operational concept
- Desire crew collaboration in design process

Observation/Finding

- The Space Ops committee believes there are significant operational challenges with “Commercial approach to ISS crew launch/return.” NASA is certainly up to these challenges. There is much work ahead, and this should begin with a sense of urgency. Previous experience with new launch systems has shown that schedules are frequently optimistic; NASA should have a plan in the event commercial launch is not ready when expected. NASA has emphasized to us that crew safety is paramount, as well as insuring the ISS mission is supported, in a reliable, cost-effective manner. Many years from now, NASA should not find itself in a trade-off of crew safety with de-crewing of ISS.

Commercial Crew: Conclusions

- There are many programmatic and safety-related uncertainties with relying solely on the commercial crew concept
- The foremost concern is a potentially extended period during which the US does not have indigenous access to low Earth orbit
- A strong NASA-Commercial relationship is needed for the expeditious transition to a commercially developed, human-rated launch system

Summary of Activities

- Johnson Space Center Site Visits – new technology
- Workforce Issues
- Space Shuttle Update
- International Space Station Update
- ISS as a Future Exploration Testbed
- Commercial Crew Issues
- Joint Meeting with Commercial Space Committee

Future Activities

- Formulate 2011 Work Plan
- Next meeting: February 7-8, 2011 at NASA Headquarters