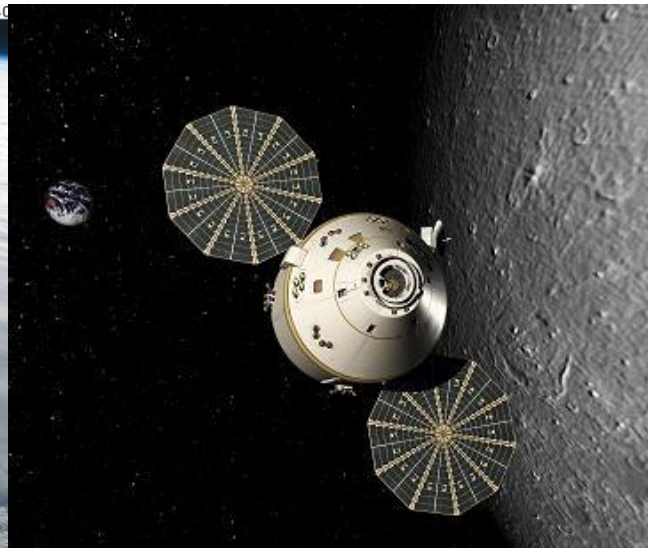
Mission Operations Directorate
New Employee Orientation

February 2011



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MISSION OPERATIONS DIRECTORATE

Paul S. Hill, *Director*
Stephen A. Koerner, *Deputy Director*
Karen E. Jackson, *Associate Director*
Kelly B. Beck, *MOD Space Shuttle Manager*
Michael G. Hess, *MOD Space Station Manager*
Stanley J. Schaefer, *Chief Engineer*
Michelle S. Gonzales, *Assistant to the Director for Procurement*

DA

NOAA – NATIONAL WEATHER SERVICE
SPACEFLIGHT METEOROLOGY GROUP
Frank C. Brody, *Chief*
WS8

PROJECTS PROCUREMENT OFFICE
DA/SA TEAM
Delene B. Sedillo, *Lead*
BH4

JSC PROJECTS RMO
MISSION OPERATIONS TEAM
David W. Yeary, *Lead*
LV2

MANAGEMENT INTEGRATION OFFICE
James V. Thornton, *Manager*
Earl G. Woods, *Deputy Manager*
DA3

MOD EXPLORATION PROJECT OFFICE
Jimmy L. Spivey, *Manager*
DA4

TECHNICAL INTEGRATION AND PRODUCTION CONTROL OFFICE
Jean C. Haensly, *Chief*
James T. Ruszkowski, *Deputy Chief*
DA6

SPACEFLIGHT TRAINING MANAGEMENT OFFICE
Annette P. Hasbrook, *Chief*
Sarah L. Murray, *Deputy Chief*
DA7

FLIGHT DIRECTOR OFFICE
John A. McCullough, *Chief*
Norman D. Knight, *Deputy Chief*
DA8

MISSION OPERATIONS FACILITIES DIVISION
Daniel D. Lindner, *Chief*
John T. Sims, *Deputy Chief*
DD

EXPEDITION VEHICLE DIVISION
Jeanne S. Lynch, *Chief*
Brian L. McDonald, *Deputy Chief*
DI

FLIGHT DYNAMICS DIVISION
Robert D. Banfield, *Chief*
Richard T. Gavin, *Deputy Chief*
DM

OPERATIONS DIVISION
Peter J. Beauregard, *Chief*
Joseph H. Cavallaro, *Deputy Chief*

SPACE TRANSPORTATION VEHICLE DIVISION
Gregory T. Oliver, *Chief*
James A. Azbell, *Deputy Chief*
DS

EVA, ROBOTICS, AND CREW SYSTEMS OPERATIONS DIVISION
Susan B. Rainwater, *Acting Chief*
Kwatsi L. Alibaruho, *Acting, Deputy Chief*
DX

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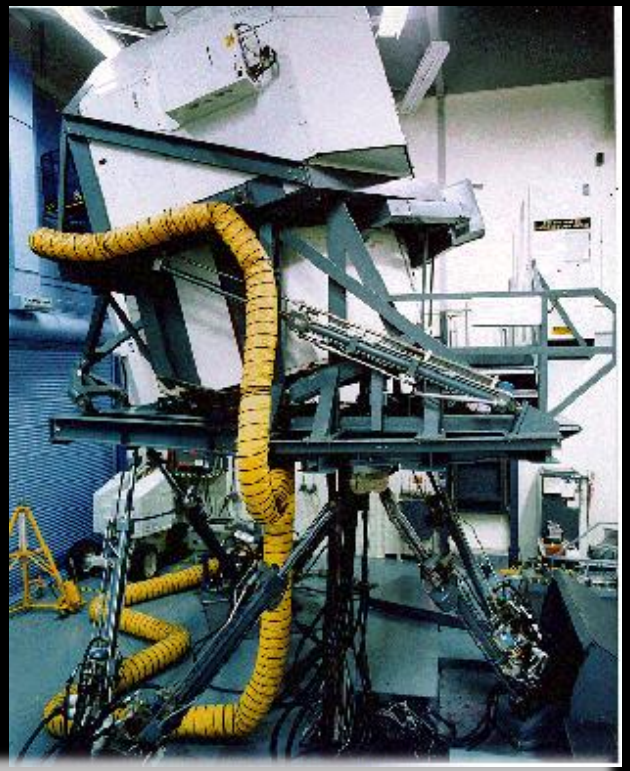

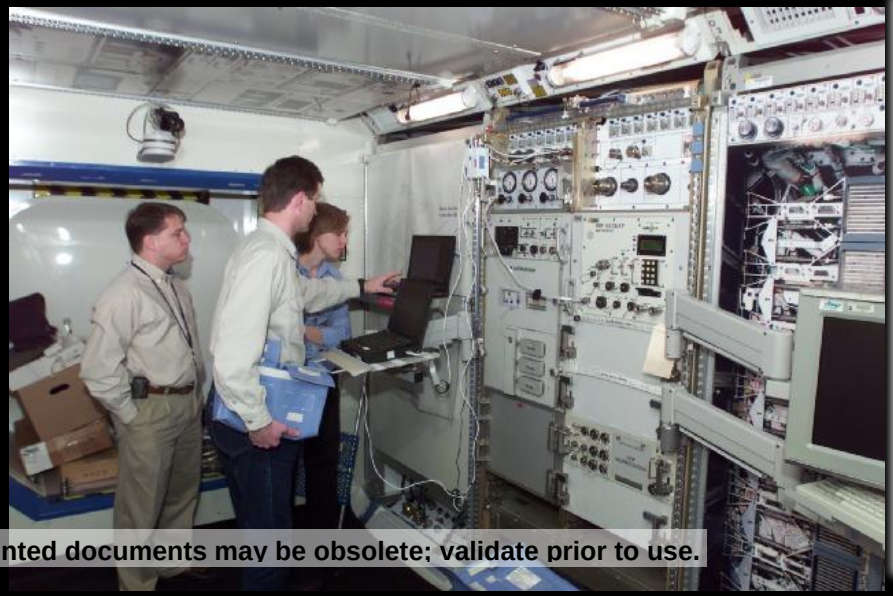

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Mission Operations: What We Do

Plan

Mission Concept Definition

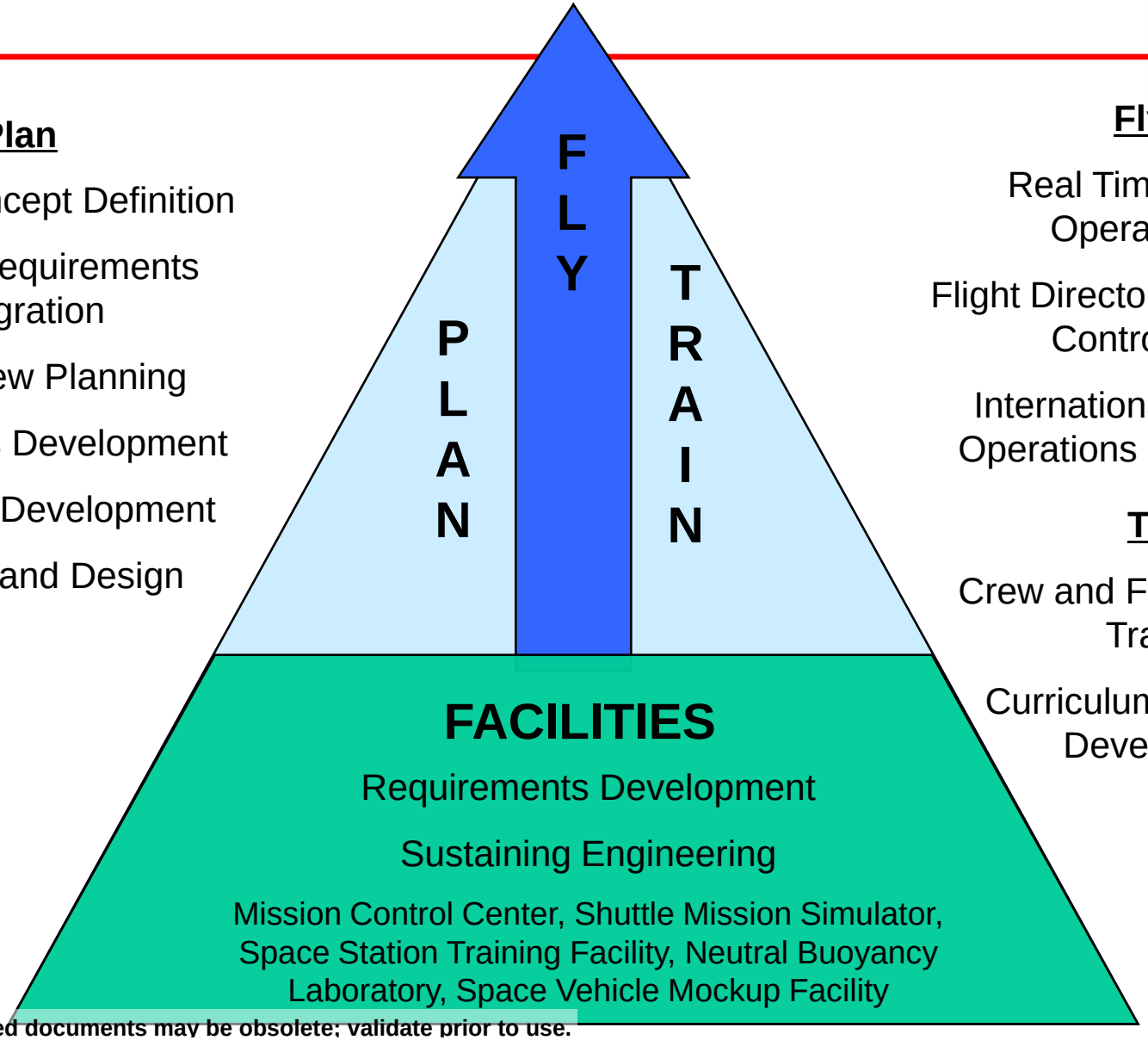
Mission Requirements Integration

Flight Crew Planning

Flight Rules Development

Procedure Development

Analysis and Design



Fly

Real Time Flight Operations

Flight Directors and Flight Controllers

International Partner Operations Integration

Train

Crew and Flight Controller Training

Curriculum Design and Development

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Flight Preparation

- **Early flight planning begins 12 -24 months pre-flight.**
  - Document payload constraints and primary mission objectives.
  - Initial timelines for training, consumables loads, etc.
  - Primarily the planners and payload specialists.
- **L-18 to L-6 months includes meetings to fill in details.**
  - Initial flight procedures.
  - Primarily the planners and payload specialists, also Flight Director, crew and flight designers.
- **After L-6 months, control team is assigned.**
  - Actual flight procedure review process.
  - Series of operations meetings to study detailed operations.
  - Simulations begin at L-3 months.
- **L-2 weeks begins flight readiness reviews.**
  - Shuttle data loads, procedures, consumables are on-board.
  - MCC configuration tested and ready for flight.
  - All training complete, ready to launch.

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A Day in the MCC

- **3 teams work approximately 10 hour shifts.**
  - 1 hour overlap at the end to handover to next shift.
  - On-coming team briefs its Flight Director, then takes responsibility for the control center and spacecraft.
  - The team on duty during the crew's sleep replans the next day.
- **~13-18 disciplines:**
  - *gpo*, fdo, prop, gnc, p/l, dps, inco, egil, mmacs, eecom, fao, *pdrs, eva, booster, rio*, surgeon, pao, gc, capcom, flight
- **Each controller monitors multiple voice loops, as well as system data.**
  - Minimum of 4 loops.
  - Flight Director, air-to-ground, discipline call loop, internal discipline loop, other system call or internal loops, payload customers, etc.
  - All traffic stops for air-to-ground, and all decisions are made on the Flight loop.
- **Various engineering reports daily.**
  - Analysis required for flight controllers.
  - Consumables and mission status for management and analysts.
  - Updated plan and procedures for the crew and flight control team.

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Order in the Chaos

- **Flight Director is responsible for every action taken in flight.**
- **Each discipline has a "front room" flight controller**
  - Front room controllers are responsible for their systems and the interfaces to the other systems and advise the Flight Director accordingly.
  - Some of them also have around 1 - 3 additional engineers in back rooms who each focus on a specific facet of the given system and advise the front room controller.
  - The controllers also discuss system performance with a separate group of engineers dedicated to analysis of problems that give us time to optimize a response.
- **Well reviewed and tightly controlled procedures are used whenever possible.**
  - Nominal ops, malfunctions and emergencies.
  - Minimizes error by reinventing the right thing to do when it happens.
  - Keeps the crew and MCC in synch while flying or reacting to problems.
  - Controlled flight rule and procedure change process.
  - Most of MOD's work is flight rule and procedure development and evolution
- **Communications are focused and concise.**
  - Controller input to Flight Director must be unambiguous for timely, accurate decision making.
  - Similarly, clear direction needed for the crew.

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Why?

- Mercury 9 — Gordon Cooper manual entry
- Gemini 8 — Gemini jet fail-on while docked to Agena
- Apollo 11 — Lunar Module s/w errors during descent
- Apollo 12 — Lightning strike during launch
- Apollo 13 — O2 tank explosion…
- STS 1 — Payload bay doors would not close
- STS 2 — Fuel Cell 1 failure
- STS 3 — APU 3 shut down
- STS 7 — APU 3 shut down
- STS 11 — RMS joint failure
- 51-D (23) — APU 3 shut down
- 51-F (26) — SSME1 shut down, SSME3 transducer, abort-to-orbit
- STS 30 — GPC 4 failure
- STS 32 — GPC 5 BFS inoperable, moved to GPC 2
- STS 49 — 3 rendezvous, Intelsat 3 man EV grab
- STS 68 — Pad abort at T-1.86s with hot O2 pump
- STS 80 — SPAS, Wake Shield, Orbiter drag & station keeping
- STS 83 — Fuel Cell shut down for substack delta-V
- STS-93 — Bus short just after SRB ignition
- STS-102 — Freon Loop-1 freeze in the radiator
- STS-106 — All ISS C&C computers failed.

"Failure is not an option."
Eugene F. Kranz, White Flight

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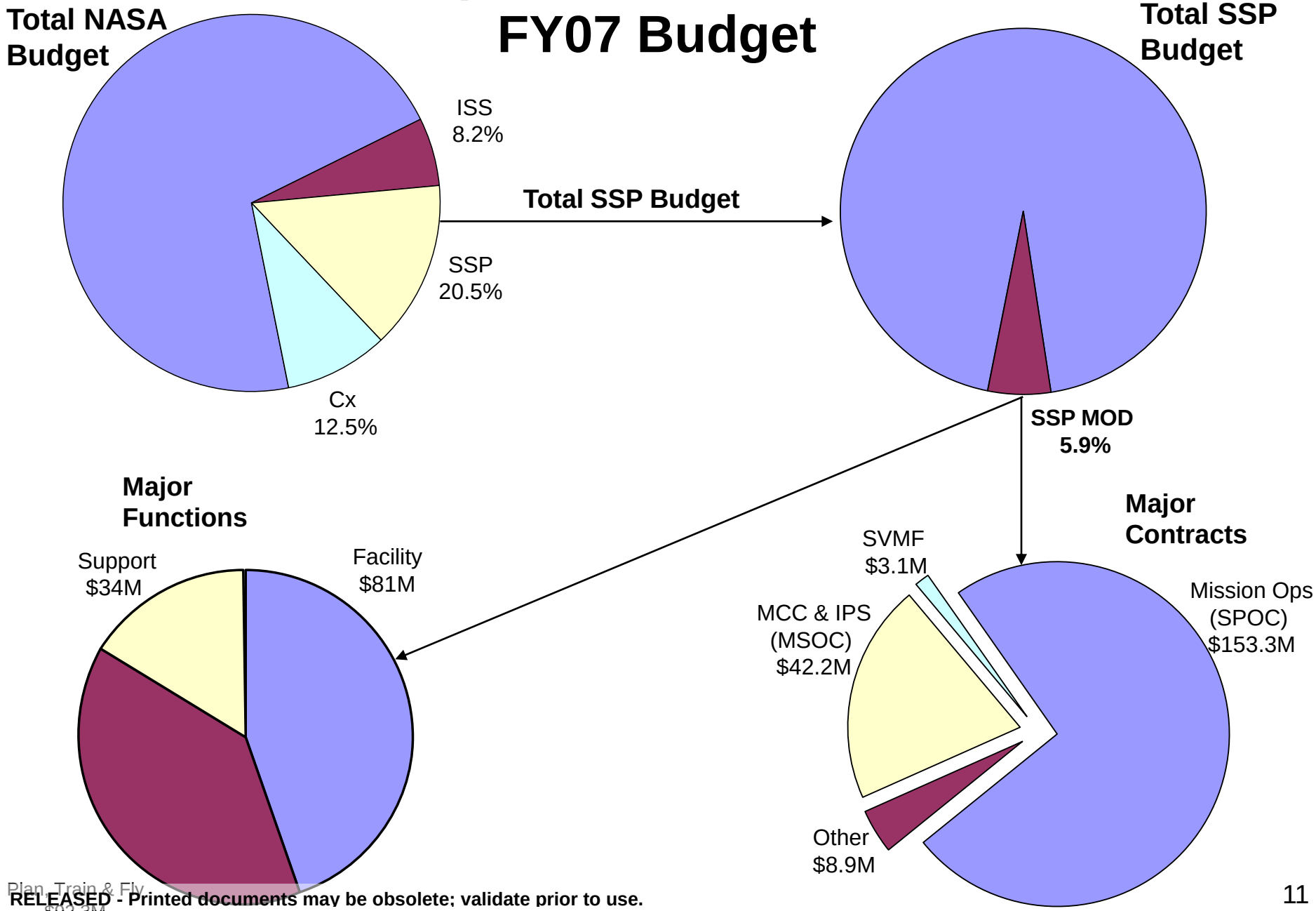
MOD Space Shuttle Contracts FY07 Budget



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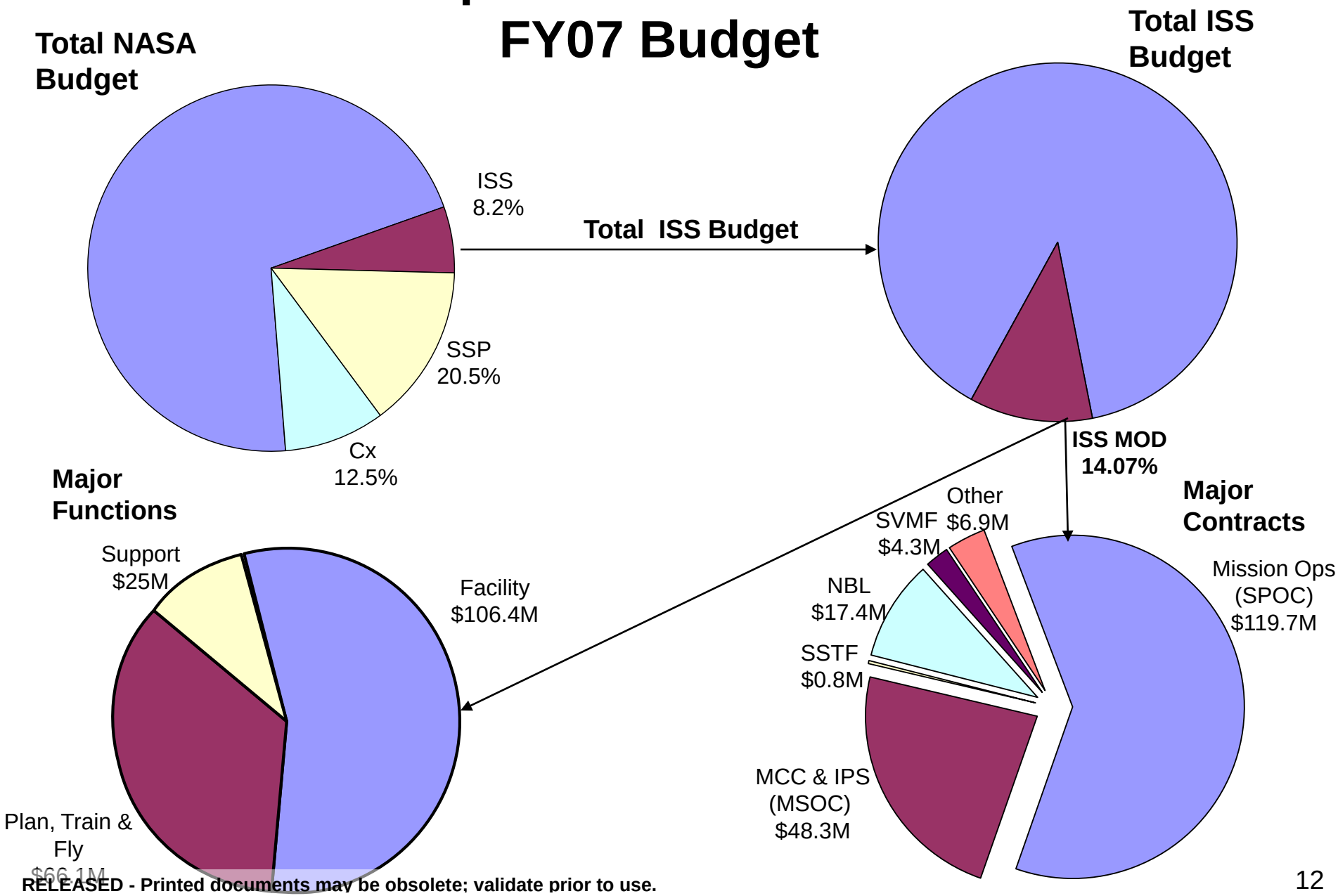
MOD Space Station Contracts FY07 Budget



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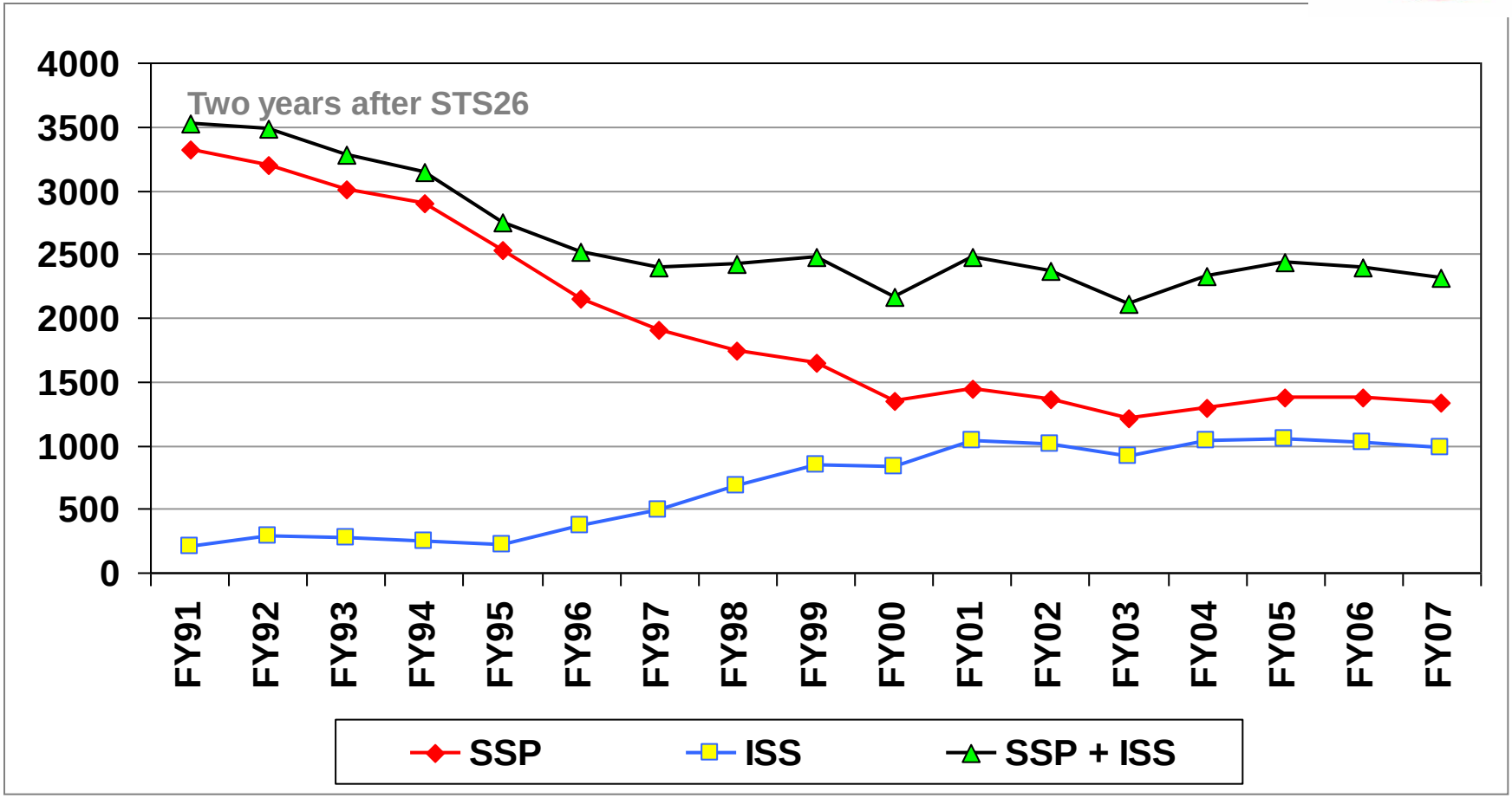
Operations Workforce History



The cost of SSP and ISS Operations in FY01 is 30% less than the cost of SSP operations alone in FY91.

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Aligning for Change

- **Reorganized in 2007 to align MOD organizationally with evolving operations.**
  - **Focus on the way we train astronauts, flight controllers/instructors and manage facilities.**
    - **Merged Flight Control and Training to consolidate technical discipline expertise.**
    - **Established a Training Integration and Management Office.**
    - **Established an Integrated Facilities Organization.**
  - **Will continue to evolve through a variety of efforts over the next one and five year periods.**
  - **Significantly changing the way we do business but maintaining the standards of professional excellence for who we are and what functions we perform.**

Foundations of Mission Operations

1. ***To instill within ourselves these qualities essential to professional excellence***
   - ***Discipline****…Being able to follow as well as to lead, knowing that we must master ourselves before we can master our task.*
   - ***Competence****…There being no substitute for total preparation and complete dedication, for space will not tolerate the careless or indifferent.*
   - ***Confidence****…Believing in ourselves as well as others, knowing that we must master fear and hesitation before we can succeed.*
   - ***Responsibility****…Realizing that it cannot be shifted to others, for it belongs to each of us; we must answer for what we do, or fail to do.*
   - ***Toughness****…Taking a stand when we must; to try again, and again, even if it means following a more difficult path.*
   - ***Teamwork****…Respecting and utilizing the abilities of others, realizing that we work toward a common goal, for success depends upon the efforts of all.*
   - ***Vigilance****... Always attentive to the dangers of spaceflight; Never accepting success as a substitute for rigor in everything we do.*

2. ***To always be aware that suddenly and unexpectedly we may find ourselves in a role where our performance has ultimate consequences.***

3. ***To recognize that the greatest error is not to have tried and failed, but that in the trying we do not give it our best effort.***

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