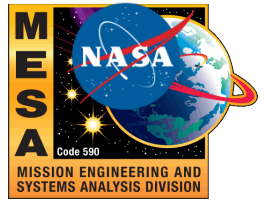
Engineering at NASA HQ

Dr. Tupper Hyde
Chief,
Mission Engineering and System Analysis Division
AETD, GSFC

Systems Engineering Seminar
10 February 2015

Outline

- **HQ Organization**
- **Project Reporting**
- **Life in the Life Cycle**
- **Even Some Real Engineering**



Administrator
Deputy Administrator
Associate Administrator

Chief of Staff
Associate Deputy Administrator
Associate Deputy Administrator for Strategy and Policy
Assistant Associate Administrator

Advisory Groups NAC and ASAP
Inspector General
Chief Financial Officer*
Chief Information Officer*
Chief Scientist
Chief Technologist

Diversity and Equal Opportunity
Education
International and Interagency Relations
General Counsel
Legislative and Intergovernmental Affairs*
Communications*
Small Business Programs

Chief Engineer
Chief, Safety and Mission Assurance
Chief Health and Medical Officer

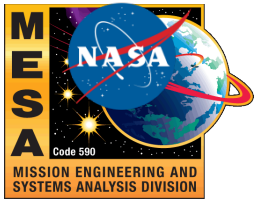
Mission Support Directorate
- Human Capital Management
- Strategic Infrastructure
- Headquarters Operations
- NASA Shared Services Center
- Internal Controls and Management Systems
- Procurement
- Protective Services
- NASA Management Office

Aeronautics Research Mission Directorate
Human Exploration and Operations Mission Directorate
Science Mission Directorate
Space Technology Mission Directorate

Ames Research Center
Armstrong Flight Research Center
Glenn Research Center
Goddard Space Flight Center
Jet Propulsion Laboratory
Johnson Space Center
Kennedy Space Center
Langley Research Center
Marshall Space Flight Center
Stennis Space Center

Reporting Structure	
	Administrator
	Deputy Administrator
	Associate Administrator

Note:
* Center functional office directors report to Agency functional AA. Deputy and below report to Center leadership.



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NASA Chief Engineer

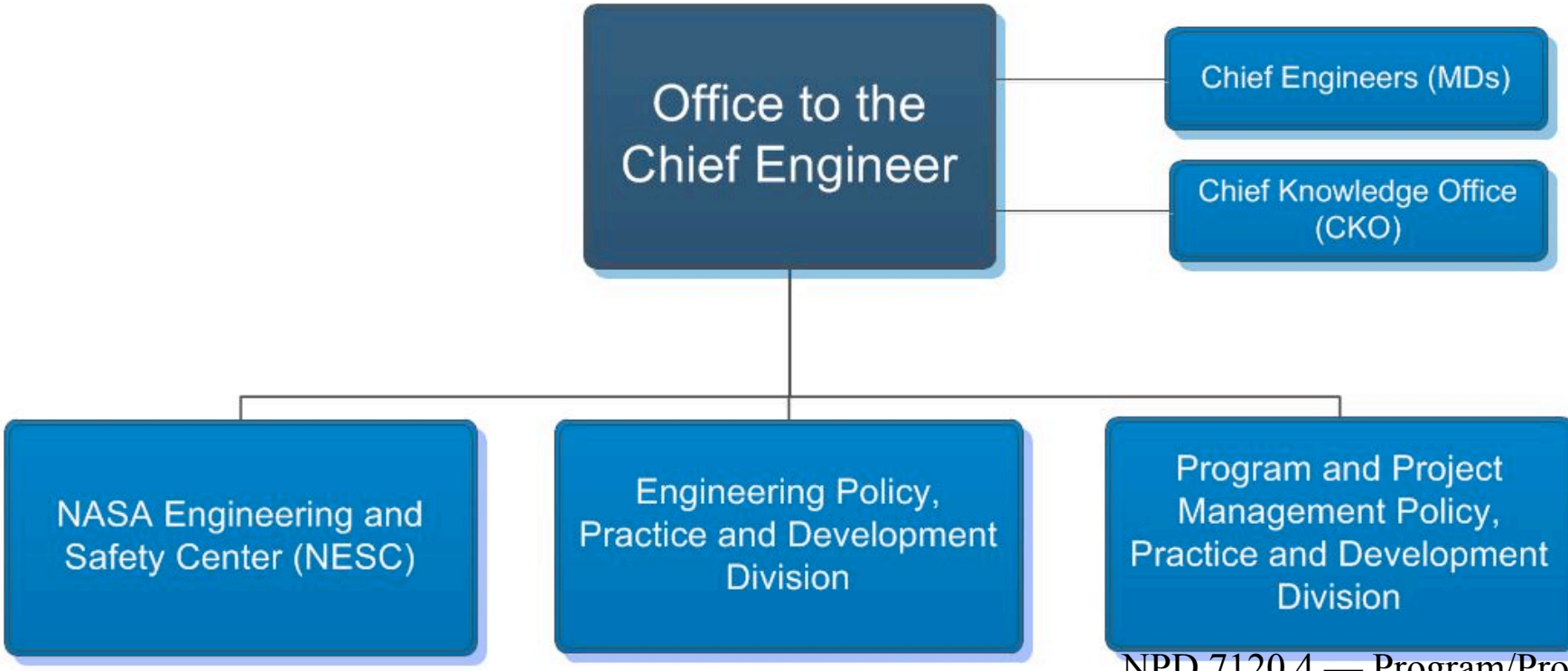
- **The Office of the Chief Engineer (OCE) provides policy direction, oversight, and assessment for the NASA engineering and program management communities and serves as principal advisor to the NASA Administrator and other senior officials on matters pertaining to the technical readiness and execution of NASA programs and projects.**

- **The OCE ensures that NASA's development efforts and mission operations are planned and conducted on a sound engineering basis with proper controls and management of technical risks.**

Michael Ryschkewitsch (2007-2014)

Ralph Roe (2014-)

OCE



NPR 7123.1, NASA Systems Engineering Processes and Requirements
NPR 7150.2, NASA Software Engineering Requirements
NPR 7120.10, Technical Standards for NASA Programs and Projects

NPD 7120.4 — Program/Project Management
NPR 7120.5 — NASA Space Flight Program and Project Management Requirements
NPR 7120.8 — NASA Research and Technology Program and Project Management Requirements

Science Mission Directorate

Earth:

- How is the global earth system changing?
- How will the Earth system change in the future?

Heliophysics:

- What causes the sun to vary?
- How do the Earth and Heliosphere respond?
- What are the impacts on humanity?

Planets:

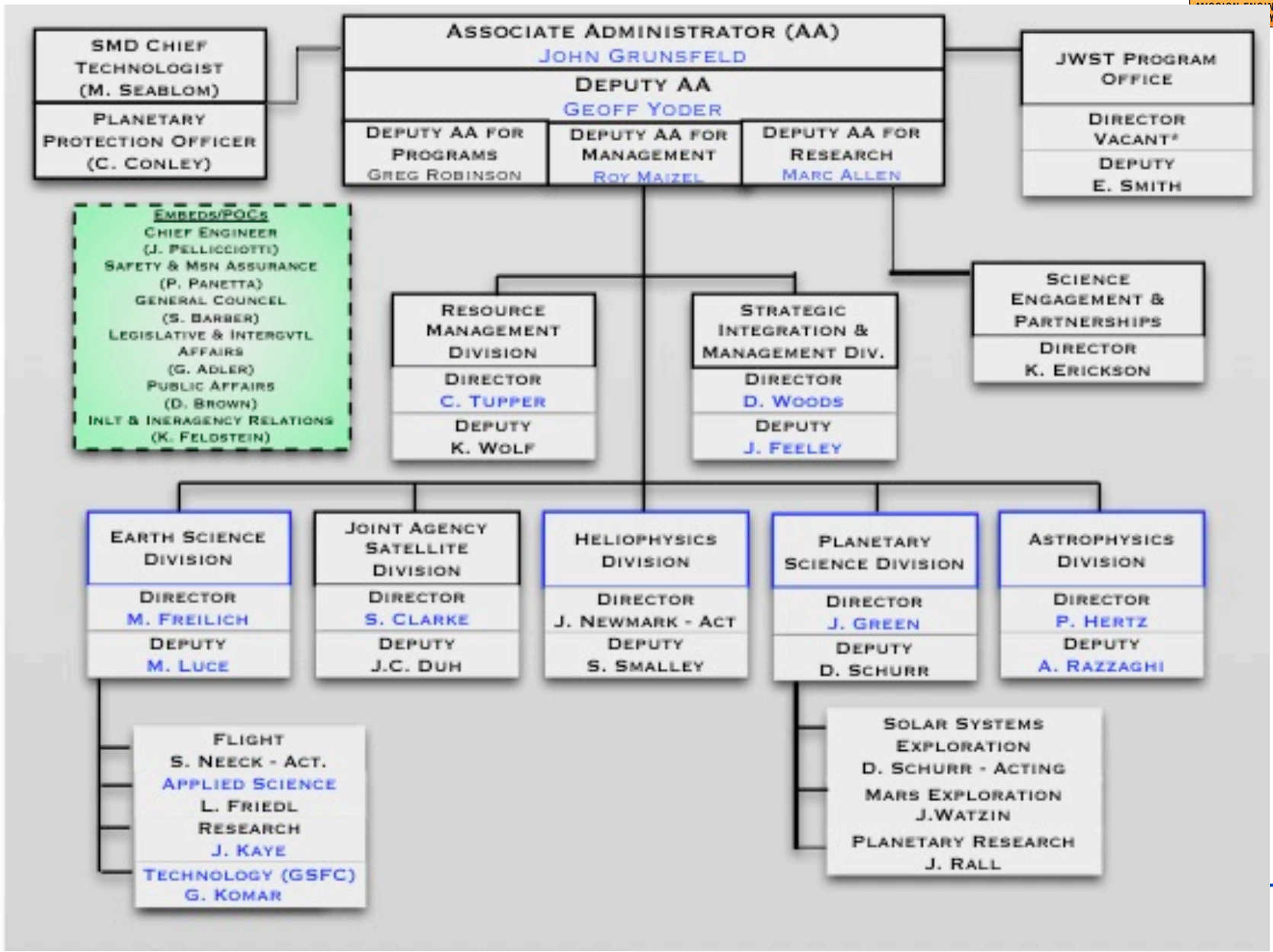
- How did the sun's family of planets and minor bodies originate?
- How did the solar system evolve to its current diverse state?
- How did life begin and evolve on Earth, and has it evolved elsewhere in the Solar System?

Astrophysics:

- How Does the Universe Work?
- How did we get here?
- Are we alone?

Dr. John M. Grunsfeld, Associate Administrator

Science Mission Directorate



SMD Project Reporting

- **Weekly (Scienceworks weekly reporting system)**
- **Monthly (Scienceworks monthly program review system):**
  - **Project and Program Monthly**
  - **Center Monthly (GSFC MSR, JPL PSR/QSR)**
  - **SMD Flight Projects Reviews (divisions to SMD DAA for Flight)**
  - **NASA Baseline Performance Review- BPR (to NASA AA)**
- **Chief Engineer role:**
  - **Question technical issues and advise SMD managers**
  - **Look for issues that cross projects/programs/centers**
  - **Make independent assessment of tech/cost/sched/programatic**
    - Along with SMA and CFO (finance) office reps.
    - Present independent assessment to AA at BPR

Astrophysics Earth Science
Heliophysics Planetary Science
Joint Agency Satellite Division (JASD)

Total Missions / Spacecraft
97 / 124

20-Jan-2015

Formulation 12 / 12

JPL 5
- *OCO-3* 7/2016
- SWOT 10/2020
- **Mars 2020** 2020
- NISAR Late 2020/2021
- *ECOSTRESS* 2018 (TBR)

LaRC 2
- *TEMPO* 11/2018
- *RBI* 11/2021

GSFC 4
- **SIDAR** TBD
- *GOLD* 9/2017
- **JPSS-2** 11/2021
- *GEDI* 2019 (TBR)

MSFC 1
- *JUICE* 2022

Implementation 25 / 39

JPL 6/7
- SMAP 1/29/15
- *ST-7* NET CY2015
- Jason-3 NET 6/4/2015
- *Euclid* 3/2020
- InSight 3/2016
- GRACE FO (1/2) 8/2017

GSFC 16/22
- **MMS** (1/4): 3/12/2015
- DSCOVR: NET 2/8/2015
- *Astro-H:* 11/2015
- *SET-1:* 9/2015
- **GOES-R (1/4)** 3/2016
- **ICESat-2**: 10/2017
- **OSIRIS-REx:** 9/3/2016
- **JPSS-1:** 11/15/2016
- *Solar Orbiter Collaboration:* 7/2017
- *MetOp-C:* 10/2018
- **JWST:** 10/31/2018
- *NICER:* 10/2016
- **Solar Probe Plus:** 7/31/2018
- *MOMA-MS:* 2018
- TESS: 8/2017
- ICON: NET 6/2017

MSFC 1
- *Strofio* 8/16/2015

LaRC 2/9
- *SAGE III-ISS* 3/2015
- CYGNSS (1/8) 10/2016

Primary Ops 14 / 15

AFRC 1
- **SOFIA**

MSFC 1
- New Horizons

JPL 4
- *Rosetta*
- Dawn
- Juno
- OCO-2

GSFC 8 / 9
- SDO
- Suomi NPP~
- Van Allen Probes (1/2)
- Aquarius
- Landsat 8~
- IRIS
- MAVEN
- GPM

Extended Ops 46 / 58

ARC 1
- Kepler

JPL 14/16
- Spitzer
- CloudSat
- GRACE (1/2)
- OSTM/Jason-2~
- QuikSCAT
- Voyager (1/2)
- *Mars Express*
- Mars Odyssey
- MER Opportunity
- Cassini
- MRO
- NEOWISE
- NuSTAR
- MSL Curiosity

MSFC 3
- Chandra
- *Hinode*
- MESSE-NGER

GSFC 27/37
- HST
- *Suzaku*
- EO-1
- *XMM-Newton*
- Swift
- Aqua
- SORCE
- IBEX
- Terra
- TRMM
- Landsat 7~
- THEMIS (1/5)
- STEREO (1/2)
- Geotail
- *Cluster II (1/4)*
- TWINS-A & B (1/2)

LaRC 1
- *CALIPSO*
- Fermi
- CINDI
- ACE
- AIM
- Aura
- RHESSI
- SOHO
- LRO
- Wind
- LAGEOS (1/2)

Div	Form	Imp	Pri Ops	Ext Ops	Total
Astro	0	6	1	9	**16**
Earth	7	5	5	13	**30**
Planet	2	4	5	9	**20**
Helio	1	5	3	15	**24**
JASD	2	5	0	NA	**7**
Total	**12**	**25**	**14**	**46**	**97**

Italics = NASA instruments on commercial, DOD, or international spacecraft
~ Operated by another agency
Updates: (1) DSCOVR moved to NET 2/8/2015
(2) Jason-3 moved to NET 6/4/2015

X / Y = # of missions / # of spacecraft

12 font: LCC > $1B
10 font: $250M < LCC < $1B
8 font: LCC < $250M
} for projects in formulation & implementation

SMD Prog/Proj Status Roll Up (4 of 14)

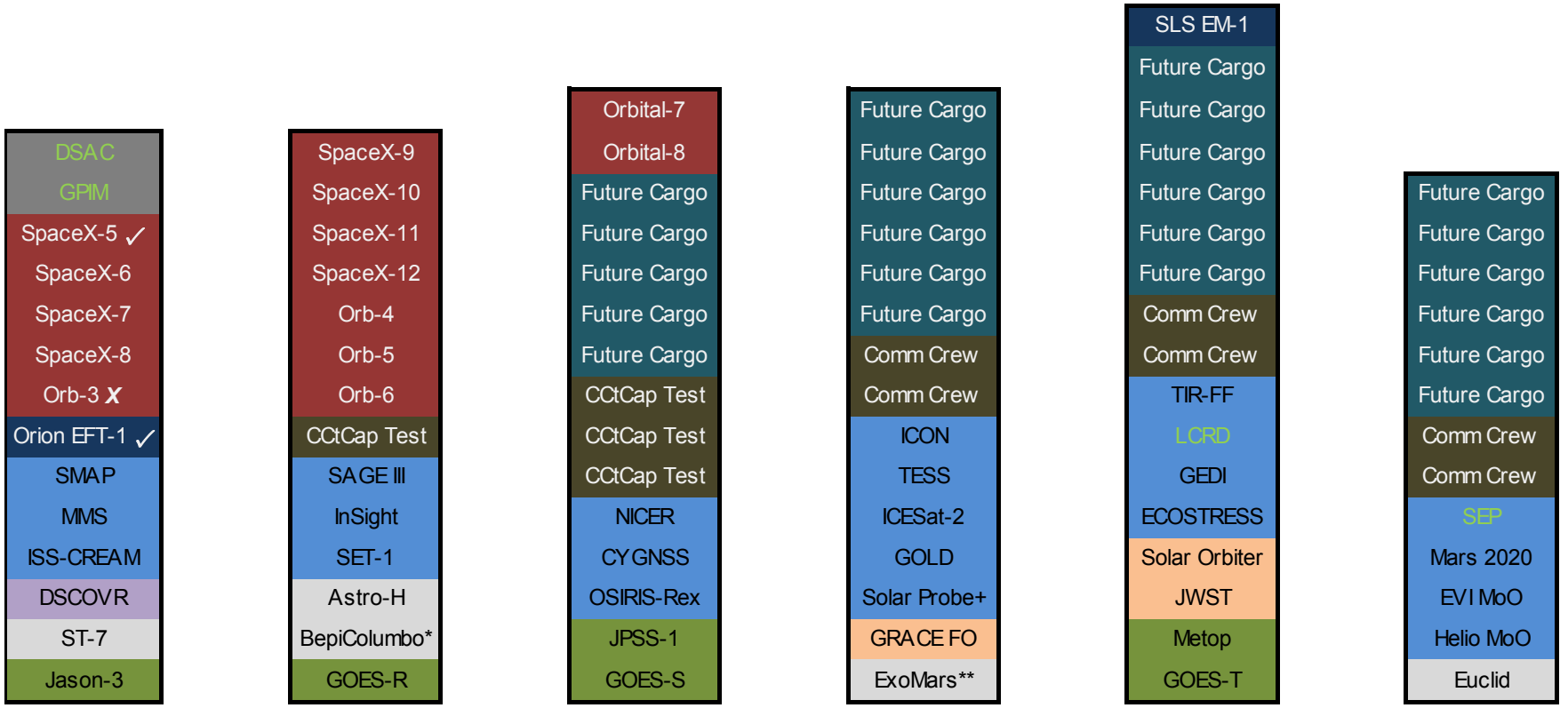
PROG. / PROJ. 2014	*Joint Agency Satellite (Part 1 of 3)*			
Joint Agency Satellite:	Impl. A M J	B A M J	C A M J	
Joint Polar Sat. Sys. (GSFC)	G G G	Formulation: JPSS–2 Implementation: JPSS-1		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx. **SCHED WATCH:** xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxx.
JPSS-1 (Flt Sys) (GSFC)			G G G	**TECH WATCH:** xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx. **SCHED WATCH:** xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxx. .
JPSS-2 (Flt Sys) (GSFC)		G G G		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx. **PROG WATCH:** xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx **SCHED WATCH:** xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.

Upcoming Launches (from FY16 Budget Slides)

- NASA Mission on US ELV
- Reimbursable Mission for NOAA
- Joint NASA-NOAA-USAF Mission
- Joint NASA-Int'l Partner Mission
- Int'l Mission w ith NASA contribution
- Joint NASA-USAF Mission
- Exploration Systems Development Mission
- Commercial Orbital Transportation Services
- Commercial Crew Mission
- Commercial Resupply Services Mission
- Future Commercial Resupply Mission

✓ Mission successfully launched
X Mission unsuccessful
TDRS-M Launch service to be determined
HEO missions in w hite text
SMD missions in black text
STMD missions in green text
*NASA provided instrument is Strofio
**NASA provided instrument is MOMA-MS

*Dates reflect Agency Baseline Commitments or updated Agency schedules and may include schedule margin beyond any manifested launch dates

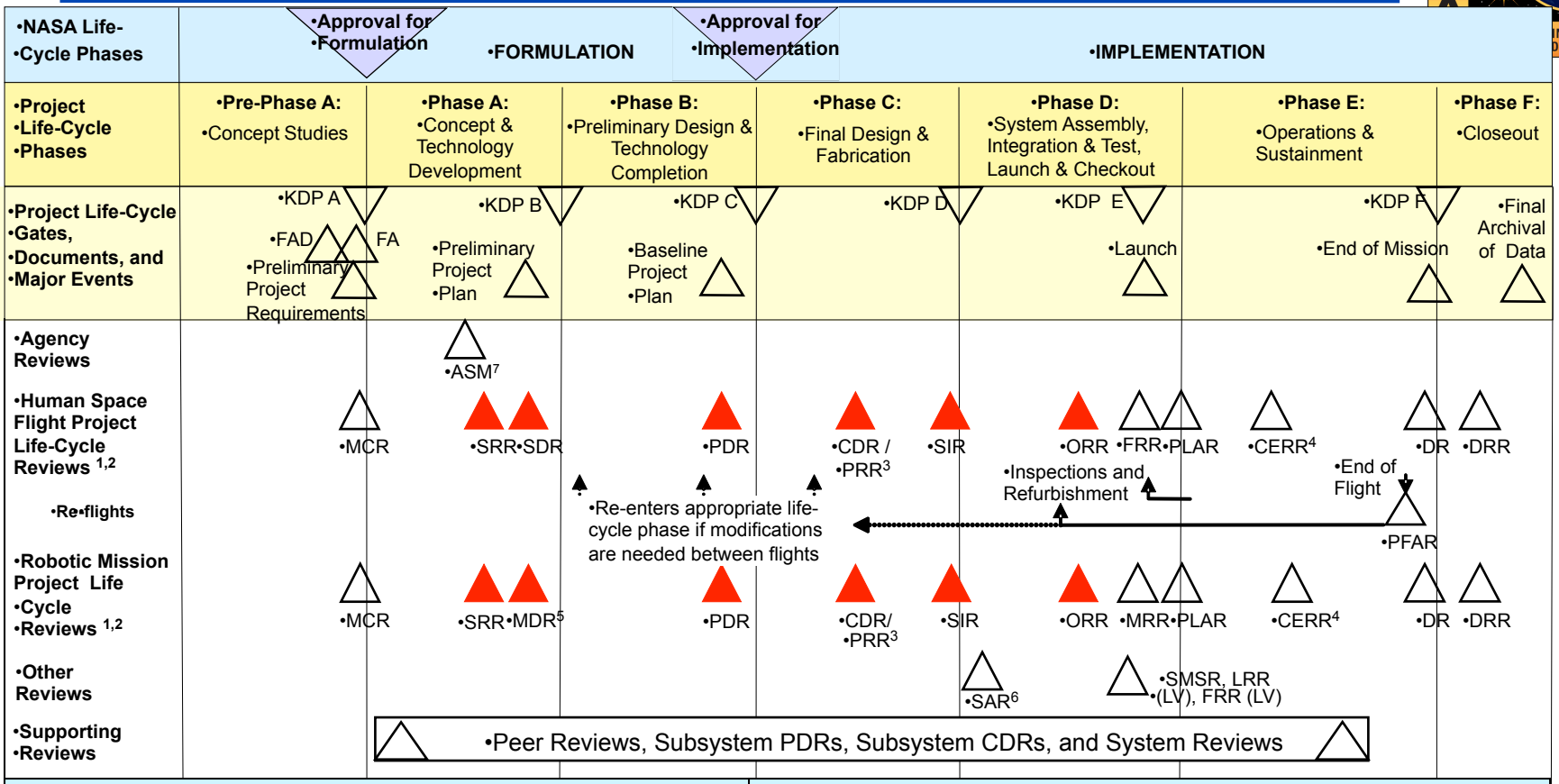


Cross-cutting Issues

- **Examples of Technical Issues:**
  - Instrument development
  - Predicted MMOD environment
  - Aging batteries
  - Increased conjunctions
  - Delta II replacement
  - Reaction wheel failures
  - Optocouplers (HV801)
  - Pu-238 supply
  - Helium supply
  - False titanium certs

- **Examples of Programmatic Issues:**
  - Readiness for KDP-C and JCL
  - Industrial base consolidation
  - IV&V requirement/prioritization
  - JPL Institutional Review Plan
  - Agency nuclear strategy
  - Protection Plans
  - Stale program plans
  - Class D/Cat 3
  - TRL definitions
  - Hosted payloads / Cubesats
  - Technology infusion

NASA Project Life Cycle (7120.5)



FOOTNOTES

1. Flexibility is allowed as to the timing, number, and content of reviews as long as the equivalent information is provided at each KDP and the approach is fully documented in the Project Plan.
2. Life-cycle review objectives and expected maturity states for these reviews and the attendant KDPs are contained in Table 2-5.
3. PRR is needed only when there are multiple copies of systems. It does not require an SRB. Timing is notional.
4. CERRs are established at the discretion of program .
5. For robotic missions, the SRR and the MDR may be combined.
6. SAR generally applies to human space flight.
7. Timing of the ASM is determined by the MDAA. It may take place at any time during Phase A.

•ACRONYMS

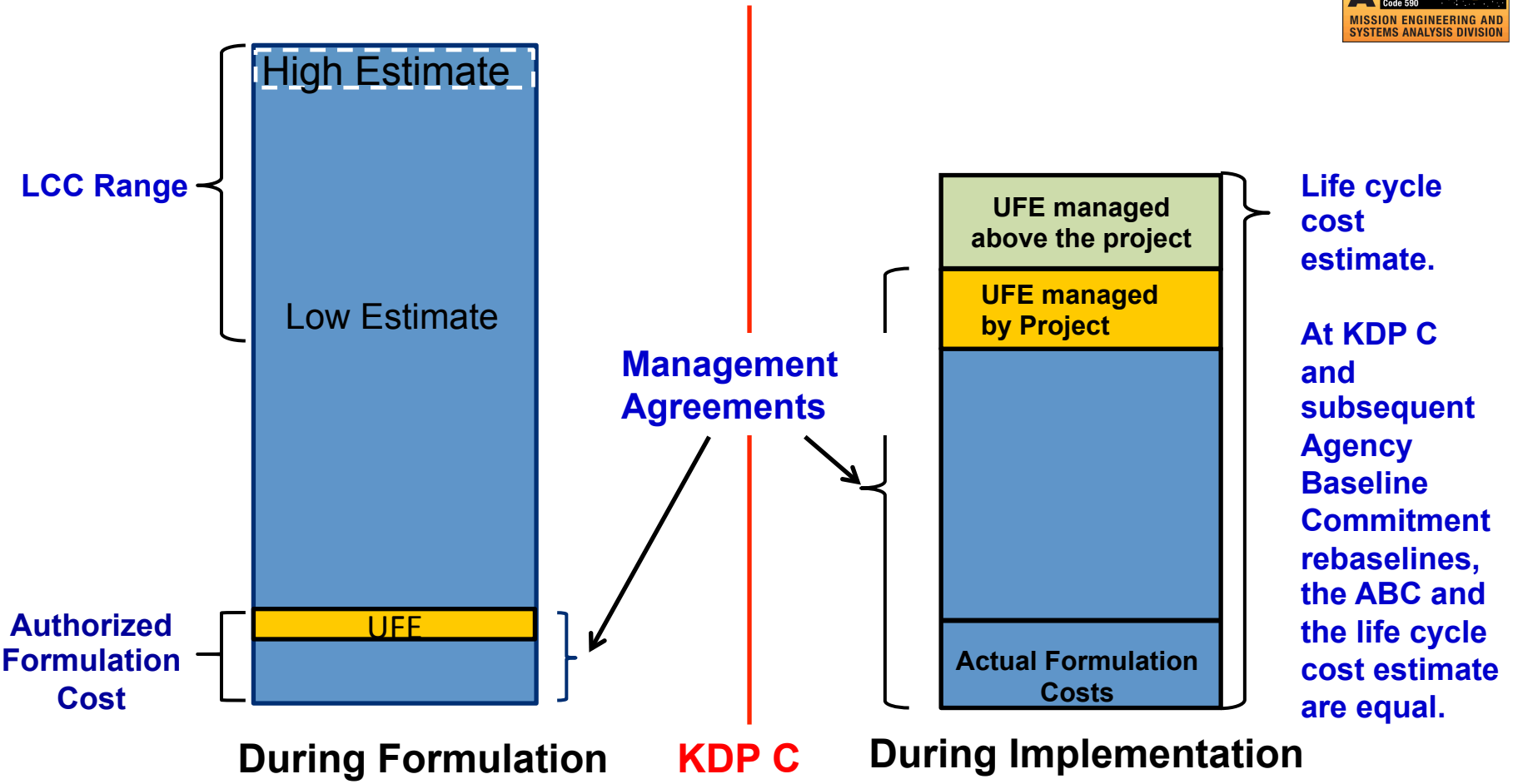
•ASM - Acquisition Strategy Meeting
•CDR - Critical Design Review
•CERR - Critical Events Readiness Review
•DR - Decommissioning Review
•DRR - Disposal Readiness Review
•FA - Formulation Agreement
•FAD - Formulation Authorization Document
•FRR - Flight Readiness Review
•KDP - Key Decision Point
•LRR - Launch Readiness Review
•LV - Launch Vehicle
•MCR – Mission Concept Review
•MDR - Mission Definition Review
•MRR - Mission Readiness Review
•ORR - Operational Readiness Review
•PDR - Preliminary Design Review
•PFAR - Post-Flight Assessment Review
•PLAR - Post-Launch Assessment Review
•PRR - Production Readiness Review
•SAR - System Acceptance Review
•SDR - System Definition Review
•SIR - System Integration Review
•SMSR - Safety and Mission Success Review
•SRB - Standing Review Board
•SRR - System Requirements Review

•Red triangles represent life-cycle reviews that require SRBs. The Decision Authority, •Administrator, MDAA, or Center Director may request the SRB to conduct other reviews.

Life Cycle Reviews -> KDPs

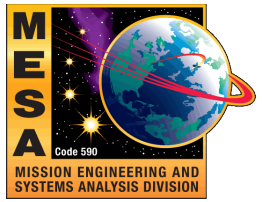
- **MCR -> KDP-A**
  - Project addresses critical need
  - Ready for formulation
  - FAD and FA signed
- **SRR/MDR -> KDP-B**
  - Success likely within resources
  - System requirements agreed to
  - Range of cost and schedule given
  - Prelim project plan written
- **PDR -> KDP-C**
  - Confirmation review
  - Prel design done and all TRL 6
  - LV selection about time of KDP-C
  - Management agreement (MA) and agency baseline commitment (ABC) cost and schedule signed
  - Project plan signed (7120.5 compliance)
- **SIR -> KDP-D**
  - Project on plan
  - Ready for final I&T
  - Reserves usage clarified
- **FRR/MRR-> KDP-E**
  - Flight, Ground, and LV ready for launch and operation
  - Risks understood
  - SMSR for Eng and SMA TAs
  - Ops budget defined
- **Decom. Rev. -> KDP-F**
  - Safe decommission ready
  - End of mission plan & letter
  - Final data plan

MA and ABC (7120.5)



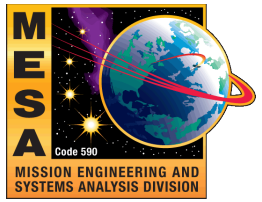
Notional and Not to Scale

And even some real engineering!

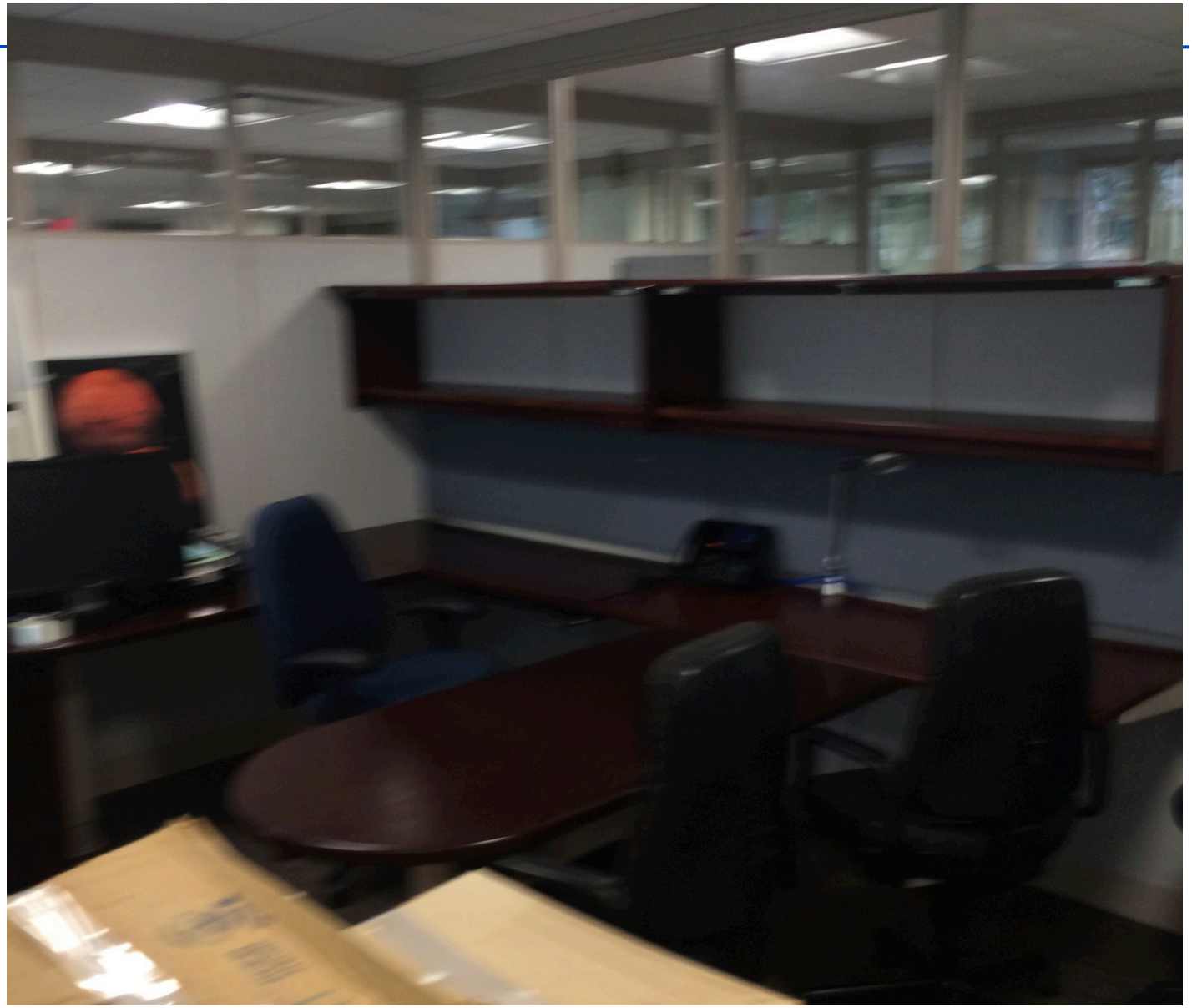


- Kepler RWA failures
- RWA Tiger team
- HV801 failures
- LDCM SADA cover
- Frangible joint
- Hybrid ACS Workshop
- LADEE:
  - Thermal vac issues
  - LLCD late integraton
  - Minotaur-V 5th stage
- OCO-2 RWA
- Pegasus (IRIS) TLX line
- 2N222 failure
- JWST Cryo-cooler
- MAVEN
  - NGIMS
  - Perth waiver
  - STATIC
- S-band Transmitter
- Kepler K2
- O-Rex SRC X-ray
- Launch COLA Policy
- Increased debris conjunctions
- ICESat-2/ATLAS Risks
- NOAA JPSS S/C Red Team
- Flight processor resets
- MRO Safing
- O-Rex GN&C Lidar
- Mars2020 planetary protection
- ISEE-3 Reboot
- ISS CubeSats near GPM
- JPSS MMOD
- STEREO antenna
- SMAP RBA deployment
- Centaur disposal

Questions



Now's the time ask everything you wanted to know about HQ but were afraid to ask!




K-A-L-A-VERAS