National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

NASA PM CHALLENGE 2009
JPL DESIGN AND FLIGHT PROJECT PRACTICES

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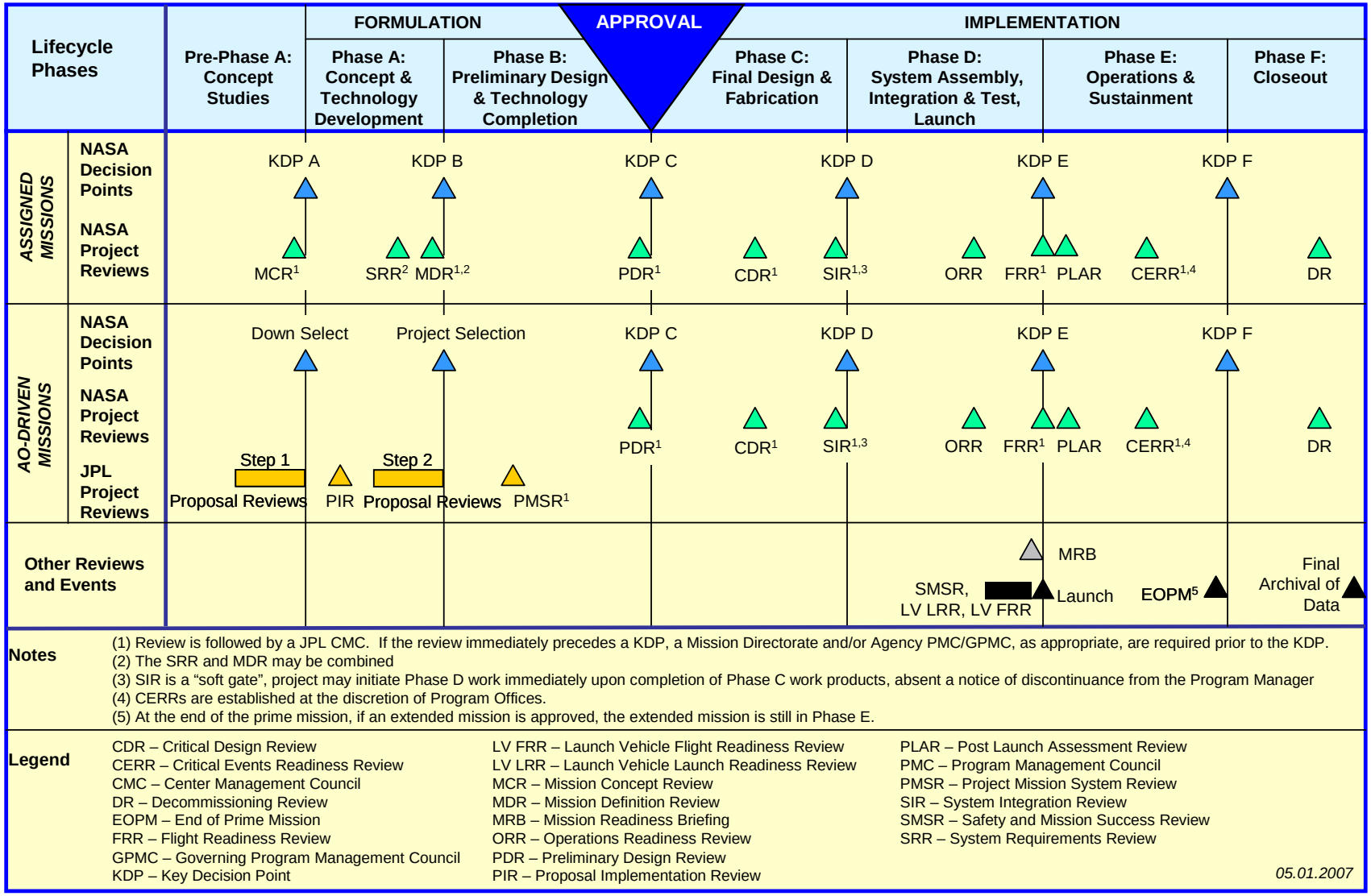
NASA/JPL Project Lifecycle

JPL Flight Program/Mission Implementation



Notes

(1) Review is followed by a JPL CMC. If the review immediately precedes a KDP, a Mission Directorate and/or Agency PMC/GPMC, as appropriate, are required prior to the KDP.
(2) The SRR and MDR may be combined
(3) SIR is a "soft gate", project may initiate Phase D work immediately upon completion of Phase C work products, absent a notice of discontinuance from the Program Manager
(4) CERRs are established at the discretion of Program Offices.
(5) At the end of the prime mission, if an extended mission is approved, the extended mission is still in Phase E.

Legend

CDR – Critical Design Review
CERR – Critical Events Readiness Review
CMC – Center Management Council
DR – Decommissioning Review
EOPM – End of Prime Mission
FRR – Flight Readiness Review
GPMC – Governing Program Management Council
KDP – Key Decision Point
LV FRR – Launch Vehicle Flight Readiness Review
LV LRR – Launch Vehicle Launch Readiness Review
MCR – Mission Concept Review
MDR – Mission Definition Review
MRB – Mission Readiness Briefing
ORR – Operations Readiness Review
PDR – Preliminary Design Review
PIR – Proposal Implementation Review
PLAR – Post Launch Assessment Review
PMC – Program Management Council
PMSR – Project Mission System Review
SIR – System Integration Review
SMSR – Safety and Mission Success Review
SRR – System Requirements Review

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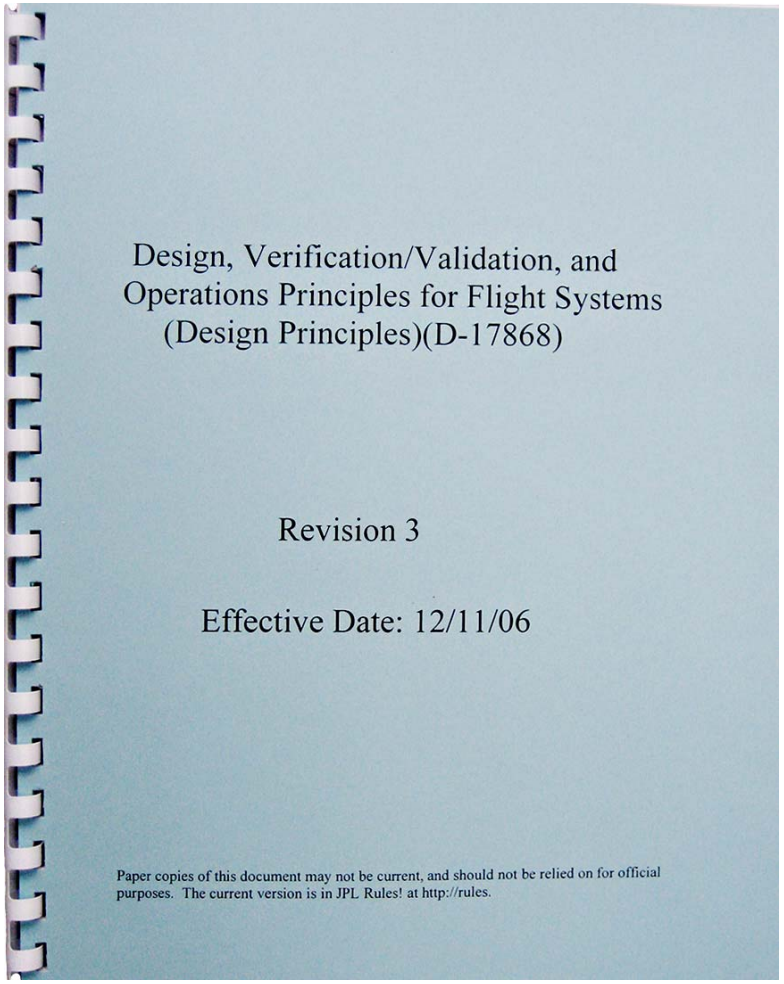
Design Principles:

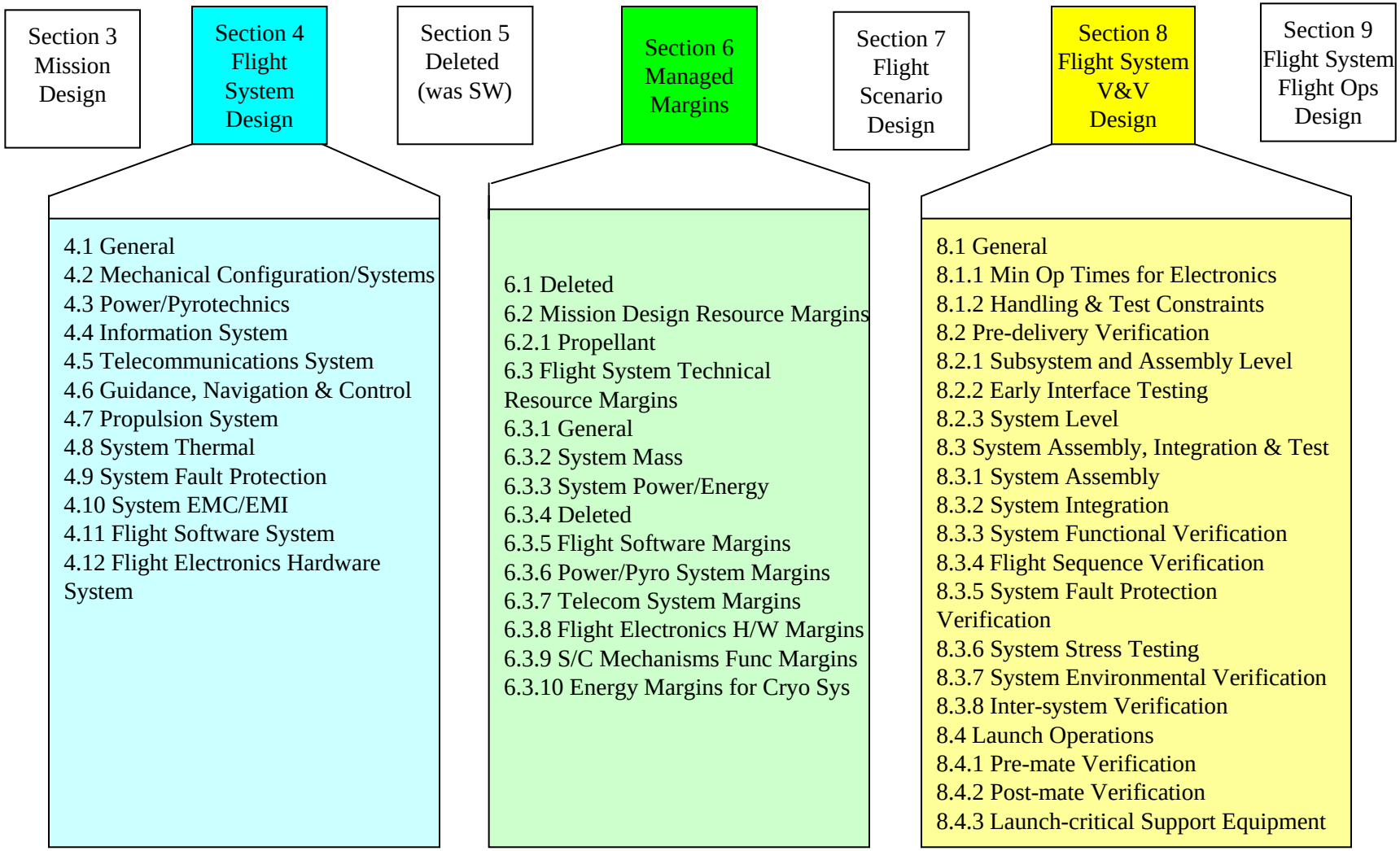


(Rules! DocID 43913)

- Applies to all flight designs, whether implemented in-house or at a contractor
- Specifies essential attributes of JPL flight designs
- Projects meet requirements, or get approval for deviation/exception
- Captures 40+ years of lessons learned
- Establishes robust design margins for high reliability
- Defines ample margins for management of development risk
- Requires a conservative approach to use of flight assets
- Prescribes a comprehensive approach to flight system V&V
- Compliance assessment is via the DP Compliance Matrix
- Deviations/Exceptions process engages management in discussion of risks being accepted
- Requires development of an Incompressible Test List and a Test as You Fly Exception List

Design Principles: Content

Note: Sections 1 and 2 are Applicability and Introduction



Margin Management: Technical Margin

Mass Margin (%)	**30%**	**20%**	**10%**	**5%**	**2% (Note 1)**
Power Margin (%) (Note 2)	**30%**	**20%**	**15%**	**10%**	**10%**
Project Milestone	PMSR (A-to-B Transition)	Project PDR (B-to-C/D Transition)	Project CDR	ATLO Readiness Review	Launch

Definitions:

Mass Margin = {(LV Allocation - CBE)/LV Allocation} x 100%

Power Margin = {(Available Power - CBE)/Available Power} x 100%

Notes:

1. Project Manager can specify other positive values, including zero
2. Power margins apply to mission critical and mission enabling modes, e.g., cruise, safing, etc.

Margin Management: Schedule Margins

Schedule Margin Rate	**1 month/year**	**2 months/year**	**1 week/month (2.8 months/year)**
Flight Missions/ Flight Experiment Projects	Implementation Start to Delivery to ATLO/ Instrument I&T	ATLO Start to Ship to Launch Site/ Instrument I&T Start to Delivery To ATLO	Delivery to Launch Site to Launch

Definitions:

Total Schedule = Planned Activities + Schedule Margin

Schedule Margin = No Planned Activities, but Funded Schedule

Schedule Margin Rate = Schedule Margin/(Planned Activity + Schedule Margin)

Margin Management: Budget Reserves

Budget Reserves (%)	**30%**	**30%**	**25%**	**20%**	**20%**	**10%**
Flight Missions/ Flight Experiment Projects	Proposals— Step-1 &/or Instrument AO (Pre-A-to-A Transition)	Proposals- Step-2 &/or Instrument AO (A-to-B Transition)	Project/ Instrument PDR (B-to-C/D Transition)	Project/ Instrument CDR	Start of ATLO/ Instrument I&T	Ship to Launch Site/ Deliver to ATLO

Definitions:

Budget Reserve = {Unencumbered Budget Reserve/Estimated Cost to Go} x 100%

Total Budget = Estimated Cost to Go + Unencumbered Budget Reserve

Notes:

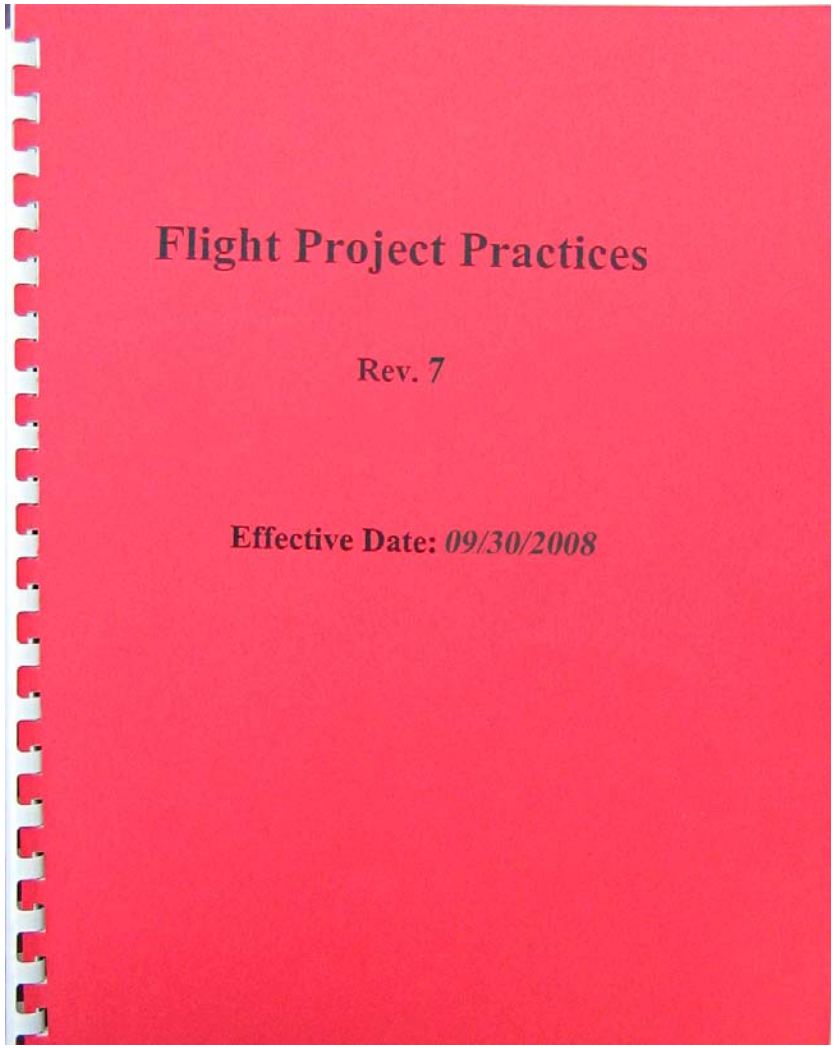
1. Cost to Go includes the funded schedule margin, but excludes the launch vehicle costs

Cost Risk Subfactors

COST RISK SUBFACTORS		COST RISK SUBFACTORS	
MISSION COMPLEXITY		**SYSTEM ARCHITECTURE**	
1. Mission with multiple flight elements (P)		1. New system architecture (P)	
2. Mission with multiple objectives		2. System architecture applied to new environment and technology	
3. Precision lander mission		3. Level 1 Requirements not well defined in formulation phase (P)	
4. Operation in harsh environments (P)		4. System with many ACS modes	
SIGNIFICANT TECHNICAL DEVELOPMENT		5. System with many deployments	
1. Mission enabling spacecraft technology with TRL<5 (P)		6. Excessive reliability requirements (P)	
2. Mission critical instrument technology with TRL<5		7.Pointing control stability requirements beyond state of art	
3. Lack of fallback option for mission critical technology		**CONTRACTOR CAPABILITIES MATCH**	
4. Multiple interfaces affected by mission critical technology		1. Contractor inexperienced in mission application (P)	
NEW SOFTWARE OR UNVALIDATED SOFTWARE INHERITANCE		2. Foreign Partner delivering hardware that is mission critical or on critical path	
1. New software architecture		3. Not enough experienced personnel available.	
2. New fault protection		**PROGRAMMATIC /COST &SCHEDULE MARGIN**	
3. New software team		1. Less then 12-month Phase A/B	
4. Undocumented software inheritance without the same development team		2. Less than 30-month Phase C/D	
TECHNICAL MARGINS		3. Schedule margins below guidelines (P)	
1. New design with multiple parameters not meeting the margin requirements specified in the design principles (P)		4. Multiple programmatic interfaces	
2. Inherited hardware with any single technical parameter not meeting the technical margin requirements specified in the design principles		**MANAGEMENT AND ORGANIZATION**	
		1. Inadequate team and management experience (P)	
		2. Insufficient workforce	
		3. Risk mitigation plan not completed during formulation phase	
		4. Selection of science instruments late in phase B (P)	

(P) = Primary risk subfactors; All others (S) = Secondary risk subfactors. Required budget reserve % = 20% + 5(number of P's)% + 2(number of S's)%

Flight Project Practices

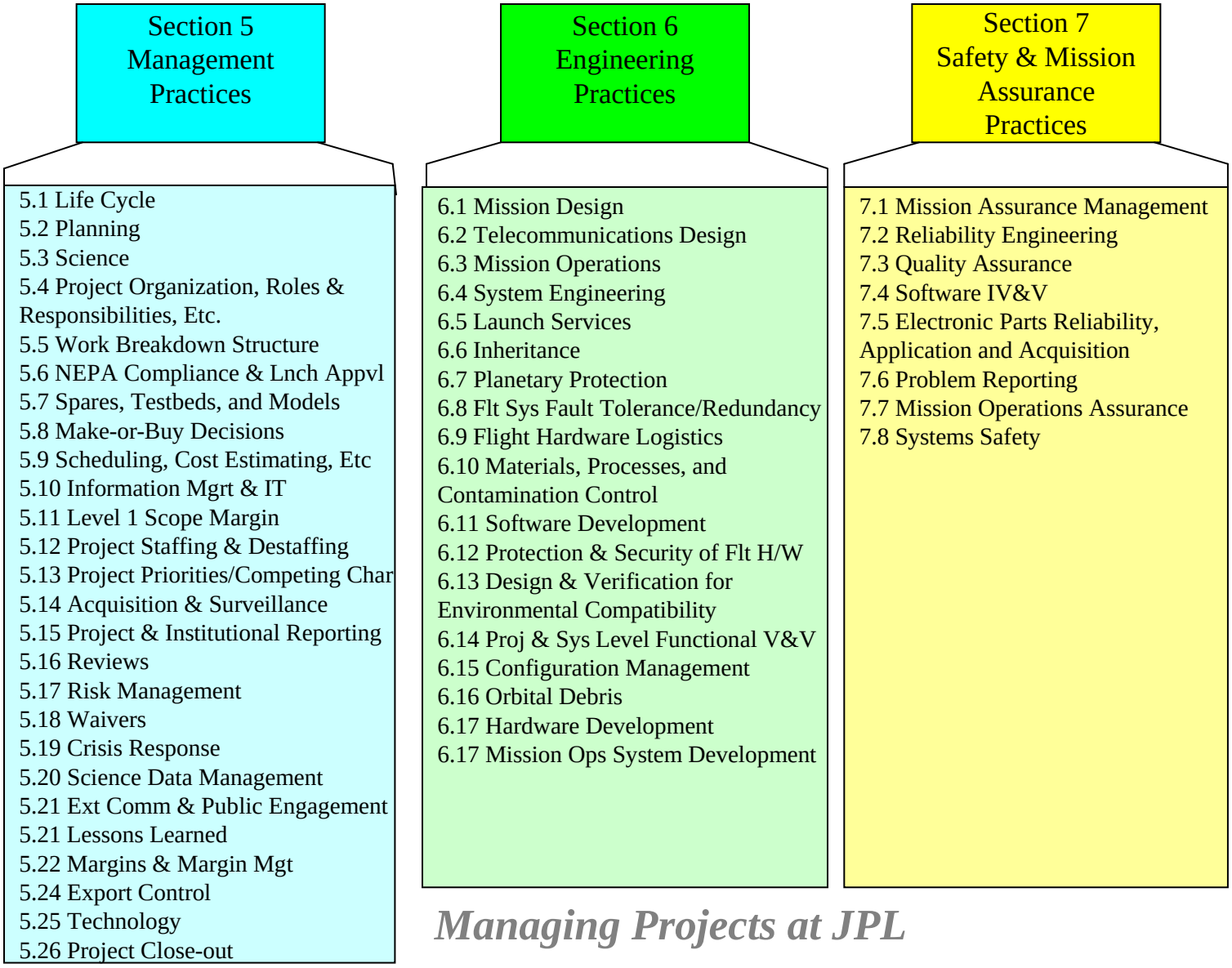


(Rules! DocID 58032)

- Applies to all projects regardless of implementation mode
- Specifies what projects are required to do
- Projects meet requirements, or get approval for deviation/exception
- Communicates the JPL way of doing business, both internally and externally, e.g. to sponsors
- Provides for projects the JPL implementation of 7120.5D
- Provides for flowdown of requirements in the JPL prime contract
- Establishes standards of uniformity
- Compliance assessment is via the FPP Compliance Matrix
- Deviations/Exceptions/Waiver process engages management in discussion of risks being accepted
- Project and Engineering Management Committee (PEMC) provides the change authority

Flight Project Practices: Content

Note: Sections 1-4 are Applicability, Purpose, Implementation, and Approval/Change Authority



Certification of Flight Readiness (CoFR)

- **The objective of the CoFR process is to formally document and capture the processes and products that, when completed, constitute a system certified as flight ready.**
  - Applies to all flight missions and instruments
  - Maximizes use of processes that we already do (minimal new work needs to be done)
  - Document is tailorable to specific missions or instruments (to be worked with OCE, SMA, Assoc. Dir.)
  - Process should be completed by the Mission Readiness Review (some open items extending to the flight readiness review are expected)
- **Two areas are covered:**
  - Products that document the project's adherence to JPL flight/mission development practices.
  - Tasks and products that document the project's residual risk to mission success.
- **CoFR process part of Project Life Cycle**
  - Organize libraries with later CoFR processes in mind, update library pointers continually
  - Use in reviews (SIR, FRR etc.) to show work being done
  - Compliance verified by audit (OCE, SMA, Assoc. Dir.) at earlier reviews
  - Start signature process within the Project well before FRR