Planetary Protection Policy as an Aspect of Mission Safety & Assurance

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Note: These charts are mostly figures and tables. The
presentation is incomplete without the verbal
explanations given during the presentation.

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• Charts are incomplete without verbal explanation

• In order to understand how PP fits with how the Agency does its work and in particular S&MA, you need to understand how NASA actually does its business.

• The Agency's approach to how work is done was improved significantly after the Columbia Accident.

• There are three parts to the presentation:

1. How the Agency manages and oversees its programs and projects
2. An example of this using the S&MA process for nuclear launches
3. How the PP policy/process compares with how the Agency manages its program and projects

The foundation for Technical Authority can be found in the NASA Governance Model - (NASA Policy Directive (NPD) 1000.0, *NASA Strategic Management and Governance Handbook*).

The checks and balances embodied in the Governance Model ensure that decisions have the benefit of different points of view and are not made in isolation.
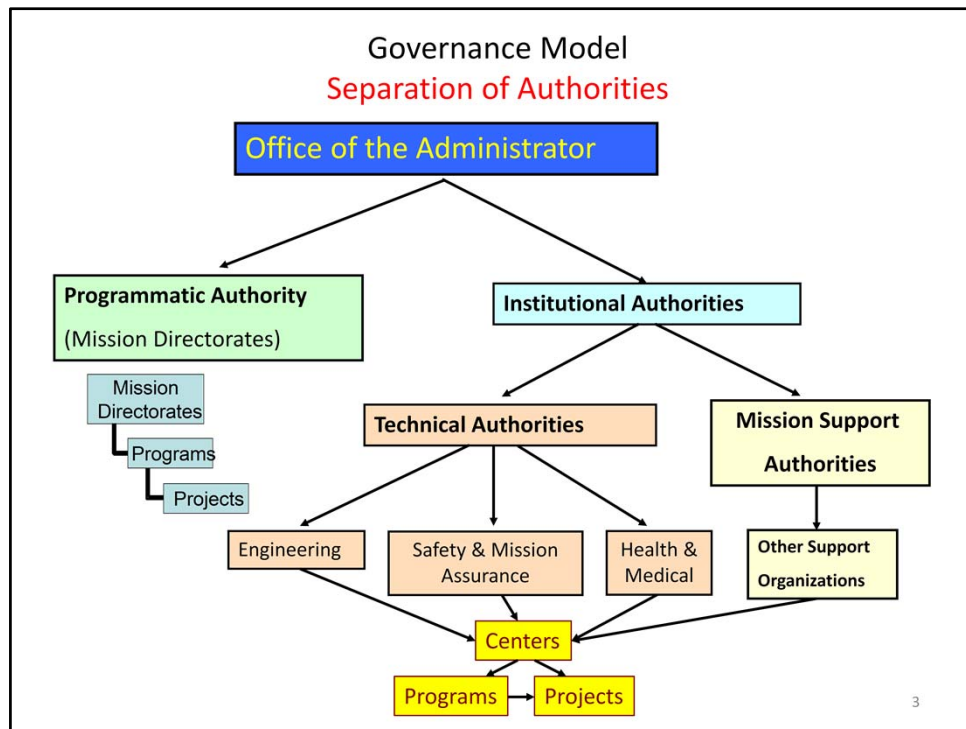
The separation enables the roles of the Programmatic and Technical Authorities to be wired into the basic organizational structure in a way that emphasizes their shared goal of mission success while taking advantage of the different perspectives each brings to issues.

Show NASA Org chart

IA/TA starts at the Administrator/Office of Administrator and flows through the heads of these orgs to the Center Directors and then to their leads and staff and finally into the programs and projects

• These authorities are formally delegated as part of this process

• As example the Chief, S&MA delegates many of his/her authorities to the Head of the Center's S&MA org; Eng TA is delegated through the CD

• IA's/TA's are responsible for ensuring that the technical aspects of the work are performed IAW the req'ts for those disciplines and that the approach will achieve the goals

reliably and safely
- IA's/TA's are funded independent of the programs/projects

- TAs are also flowed into the programs and projects.

- It is also important to understand how the programmatic authorities flow down. Explain this.

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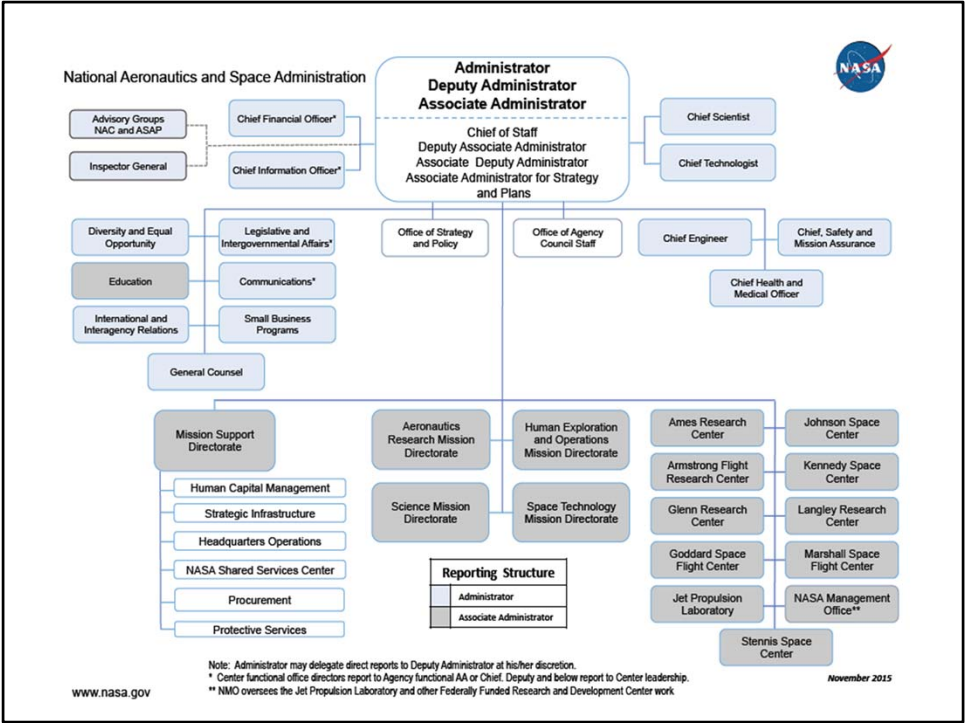
Table 1-1 Programmatic Requirements Hierarchy

Requirements Level	Content	Governing Document	Approver	Originator
Strategic Goals	Agency strategic direction	NPD 1000.0, NASA Governance and Strategic Management Handbook; NPD 1001.0, NASA Strategic Plan; and Strategic Planning Guidance	NASA Admin-istrator	Support Organiza-tions
Agency Requirements	Structure, relationships, and principles governing design and evolution of cross-Agency Mission Directorate systems linked in accomplishing Agency strategic goals and outcomes	Architectural Control Document (ACD)	NASA Admin-istrator	Host MDAA with Inputs from Other Affected MDAAs
Mission Directorate Requirements	High-level requirements levied on a program to carry out strategic and architectural direction, including programmatic direction for initiating specific projects	Program Commitment Agreement (PCA)	NASA AA	MDAA
Program Requirements	Detailed requirements levied on a program to implement the PCA and high-level programmatic requirements allocated from the program to its projects	Program Plan	MDAA	Program Manager
Project Requirements	Detailed requirements levied on a project to implement the Program Plan and flow down programmatic requirements allocated from the program to the project	Project Plan	Program Manager	Project Manager
System Requirements	Detailed requirements allocated from the project to the next lower level of the project	System Requirements Documentation	Project Manager	Responsible System Lead
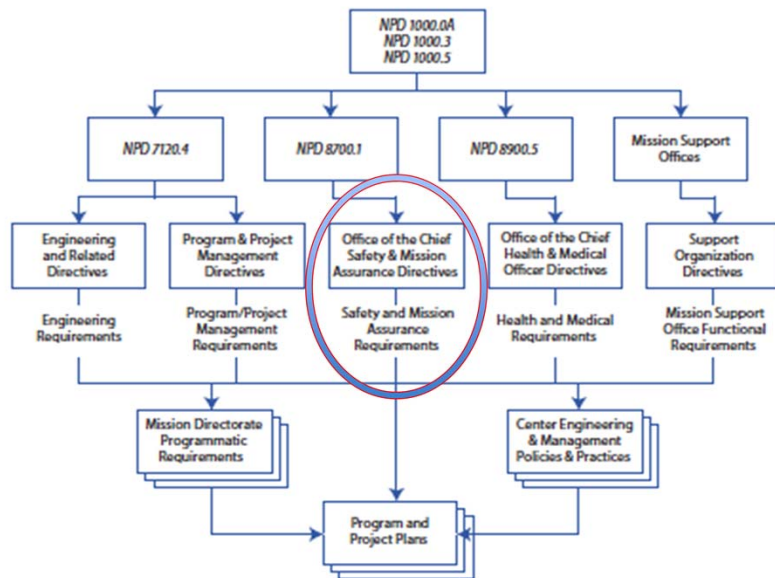
Figure 5-1 Institutional Requirements Flow Down

GODDARD SPACE FLIGHT CENTER (GSFC)
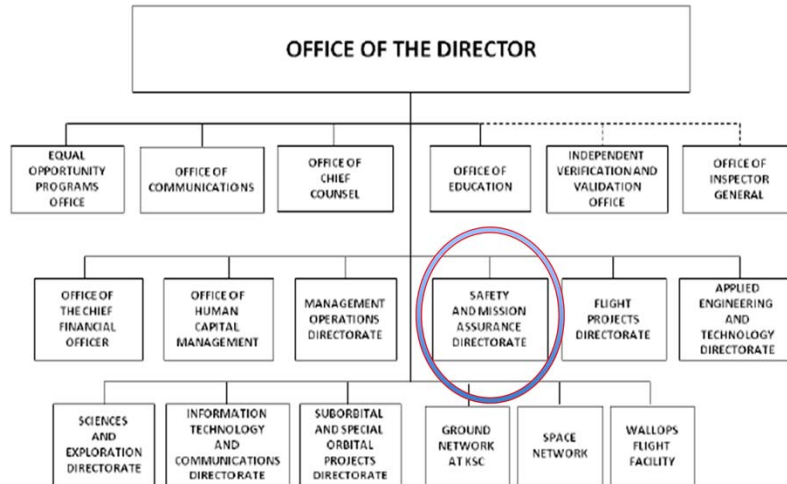
SMA Projects

Administrator
Deputy Administrator
Associate Administrator

OSMA

Center and Project Level Technical Authority

Mission Directorate AA

Center Director

Program Level

Program Manager

Center SMA Director

Project Level

Project/ Element Managers

Lead Project SMA

Direct Report
SMA Tech Authority
Program Authority
Matrix Report
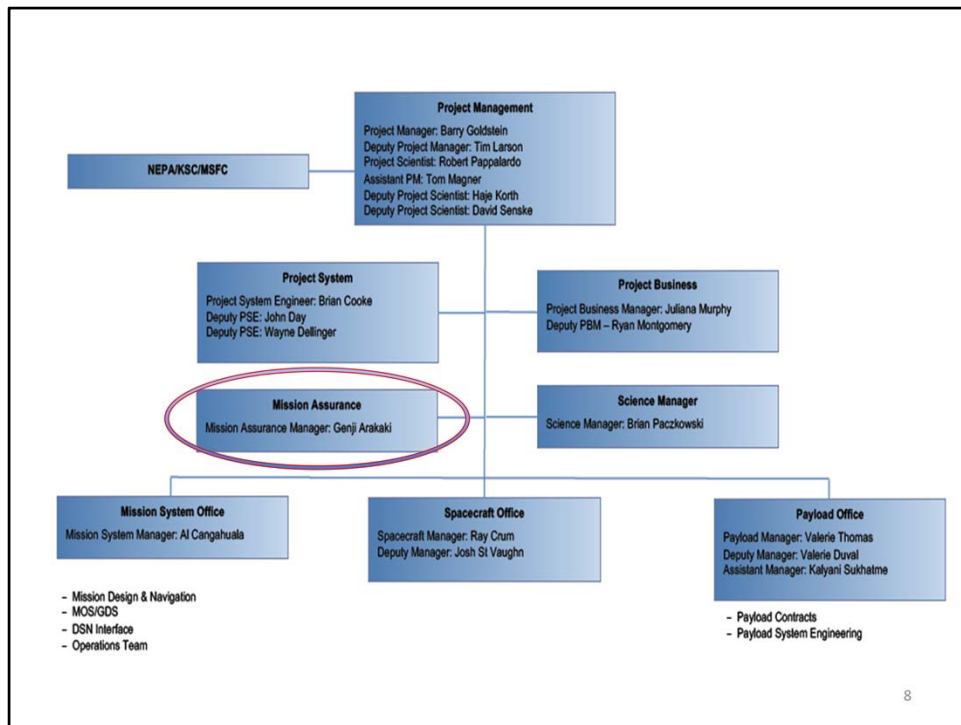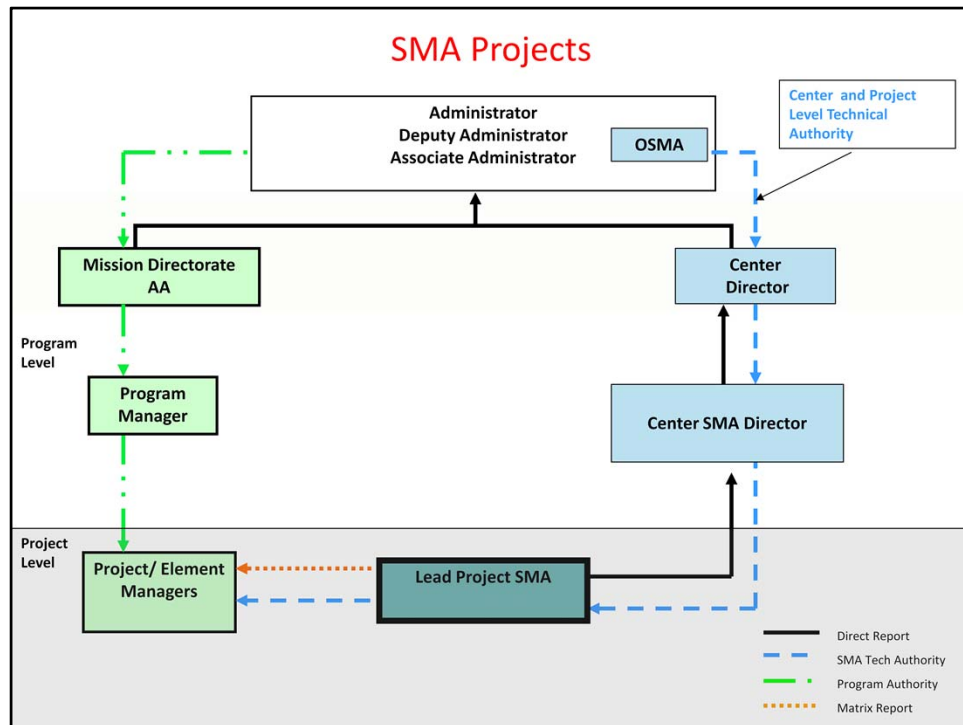
Points to note -
This is a generic presentation of SMA Technical Authority flow for projects. Variations in structure at each Center would be approved by the Chief OSMA.

Note that the flow of SMA Technical Authority for projects the flow goes directly to the Center Director. This is the same as for Engineering Technical Authority

When the Lead Project SMA is funded by the project, he/she supports the Technical Authority process, but does not have Technical Authority.
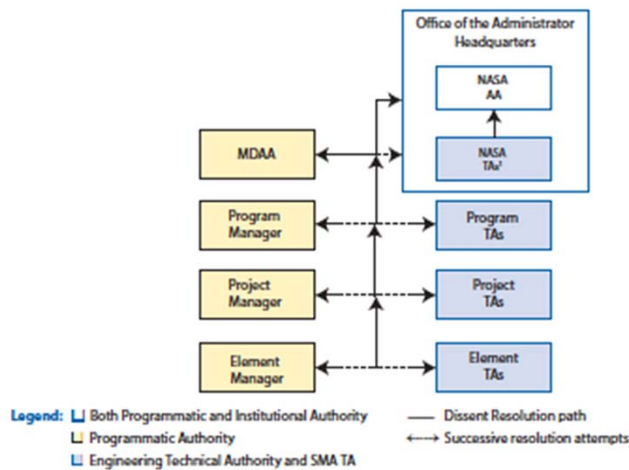
Figure 5-2 Dissenting Opinion Resolution for Issues Between Programmatic Authority and Technical Authority

Excerpt from S&MA NPD 8700.1E

a. The Administrator is the ultimate acceptance/disposition official for residual safety and mission success risks and the official Agency spokesperson to consent to any exposure to residual human safety or property risk on behalf of the general public. In this capacity, the Administrator shall--

(1) Decide cases of formal dissent to accept residual safety and mission success risks that are elevated to the Administrator (Requirement).

(2) Consent to the residual human safety or property risk on behalf of the general public in cases where the consent to take the residual human safety or property risk is not the responsibility of the Center Director (when the risk is located at or near a NASA Center or Component Facility) or the Range Commander (when the risk is associated with range operations) (Requirement).

(3) Request external approval/concurrence for risks that are not within the authority of NASA to grant (Requirement).

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Figure 3.0-1: Functional Relationships between NASA's Governing Councils.

NASA Life-Cycle Phases	Approval for Formulation — FORMULATION			Approval for Implementation — IMPLEMENTATION			
Project Life-Cycle Phases	Pre-Phase A: Concept Studies	Phase A: Concept & Technology Development	Phase B: Preliminary Design & Technology Completion	Phase C: Final Design & Fabrication	Phase D: System Assembly, Integration & Test, Launch & Checkout	Phase E: Operations & Sustainment	Phase F: Closeout
Project Life-Cycle Gates, Documents, and Major Events	KDP A ▽ FAD / FA Preliminary Project Requirements	KDP B ▽ Preliminary Project Plan	KDP C ▽ Baseline Project Plan	KDP D ▽	KDP E ▽ Launch △	KDP F ▽ End of Mission △	Final Archival of Data △
Agency Reviews		ASM[7] △					
Human Space Flight Project Life-Cycle Reviews [1,2]	MCR △	SRR SDR ▲▲	PDR ▲	CDR / PRR[3] ▲ SIR ▲	ORR ▲ FRR △ PLAR △ Inspections and Refurbishment	CERR[4] △ End of Flight	DR △ DRR △
Re-flights			Re-enters appropriate life-cycle phase if modifications are needed between flights			PFAR	
Robotic Mission Project Life Cycle Reviews [1,2]	MCR △	SRR MDR[5] ▲▲	PDR ▲	CDR/ PRR[3] ▲ SIR ▲	ORR ▲ MRR PLAR △△	CERR[4] △	DR △ DRR △
Other Reviews				SAR[6] △	SMSR, LRR (LV), FRR (LV) △		
Supporting Reviews	Peer Reviews, Subsystem PDRs, Subsystem CDRs, and System Reviews △						

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.

One OSMA Example

**Nuclear Safety for Launching of
Radioactive Materials**

Nuclear Safety for Launching Radioactive Materials Process per NPR 8715.3C, CHAPTER 6

PE consult with NFSAM & OGC if participating in another country's launch of radioactive mat'l ← Decide to do mission with radioactive materials

PE notify NFSAM as soon as radioactive sources id'd for use on S/C to schedule nuclear launch safety approval activities

PE determine level of radioactivity

$0.001 \leq A_2$	$0.001 \leq A_2 < 10$	$10 \leq A_2 < 500$	$500 \leq A_2 < 1000$	$1000 \leq A_2$	
PE/Project prepare a **Radioactive Mat'ls On-Board Report (RMOBR)**	PE/Project prepare a **Radioactive Mat'ls On-Board Report (RMOBR)**	NFSAM make prelim scoping of RAD risk to id extent of analyses req'd	NFSAM make prelim scoping of RAD risk to id extent of analyses req'd	PE & Chief, S&MA request NASA Administrator to empanel ad hoc INSRP for mission	
PE request nuclear launch concurrence from NFSAM a min of 4 mo prior to launch	PE request nuclear launch concurrence from NFSAM a min of 4 mo prior to launch	PE/NFSAM develop and document a mutual schedule for nuc safety review	PE/NFSAM develop and document a mutual schedule for Safety Analysis Summary and review activities	Chief, S&MA designates INSRP Coordinator	INSRP Coordinator facilitates INSRP activities
NFSAM review RMOBR and inform the PE in writing of concurrence (or nonconcurrence) and any concerns not less than 2mo prior to launch	**NFSAM review RMOBR and inform the PE in writing of concurrence (or nonconcurrence) and any concerns not less than 2mo prior to launch**	PE/Project prepare **NUC Safety Review** of RAD risk of mission	PE/Project prepare **Safety Analysis Summary (SAS)** of RAD risk of mission	PE/NFSAM/INSRP/Program/DOE develop and document a mutual schedule for phased delivery of Safety Analysis Report w/Final delivered NLT 10mo prior to launch	
	NFSAM periodically report to OSTP planned launch w/this radioactive mat'l prior to launch	PE/Project prepare a Radioactive Mat'ls On-Board Report (RMOBR) as part of nuc safety Review	PE/Project prepare a Radioactive Mat'ls On-Board Report (RMOBR) as part of SAS	PE/Project prepare **Safety Analysis Report (SAR)** IAW schedule for agreed iterations	INSRP reviews SAR iterations and prepares **Safety Evaluation Report (SER)**. Final SER NLT 6mo prior to launch
		PE provide Chief, S&MA & NFSAM the Nuc Safety Review & request for Nuc launch concurrence 5mo prior to launch	PE provide Chief, S&MA & NFSAM the Nuc Safety Review & request for Nuc launch concurrence 6mo prior to launch	PE/Project prepare a Radioactive Mat'ls On-Board Report (RMOBR) as part of SAR	

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LEGEND
- NFSAM Activities
- Project/mission activities
- Joint PE/Project/OSMA activities
- Other Activities

Notes: 1) Orbiting spacecraft/Space Station process not shown; 2) RAD contingency planning not shown

Flowchart boxes:

- PE provide Chief, S&MA & NFSAM the Nuc Safety Review & request for Nuc launch concurrence 5mo prior to launch
- **Chief, S&MA approves launch**
- NFSAM periodically report to OSTP planned launch w/this radioactive mat'l prior to launch

- PE provide Chief, S&MA & NFSAM the Nuc Safety Review & request for Nuc launch concurrence 6mo prior to launch
- PE provide OCHMO with SAS 6mo prior to launch
- Chief, S&MA & NFSAM review SAS and provide comments IAW sched
- Chief, S&MA concurs w/SAS
- PE forwards SAS and S&MA concurrence to NASA Administrator 4mo prior to launch & request launch approval
- **NASA Administrator approves launch**
- NFSAM periodically report to OSTP planned launch w/this radioactive mat'l prior to launch

- PE/Project prepare a Radioactive Mat'ls On-Board Report (RMOBR) as part of SAR
- *Internal NASA review process not discussed*
- NASA Administrator requests launch approval from Executive Office of the President via OSTP
- **Executive Office of the President approves launch**
- NFSAM periodically report to OSTP planned launch w/this radioactive mat'l prior to launch

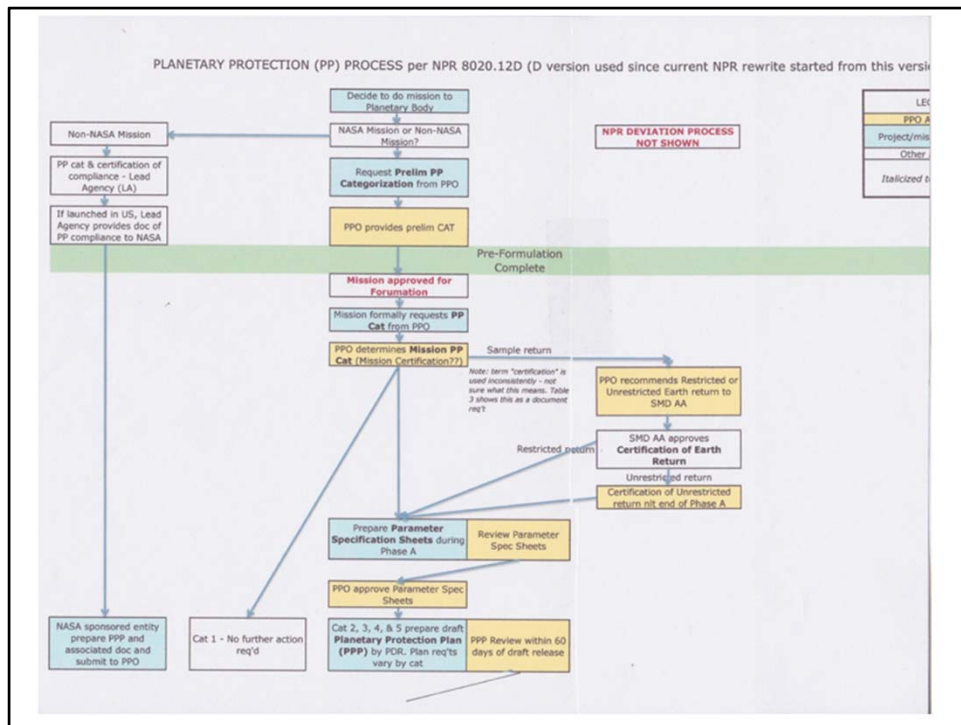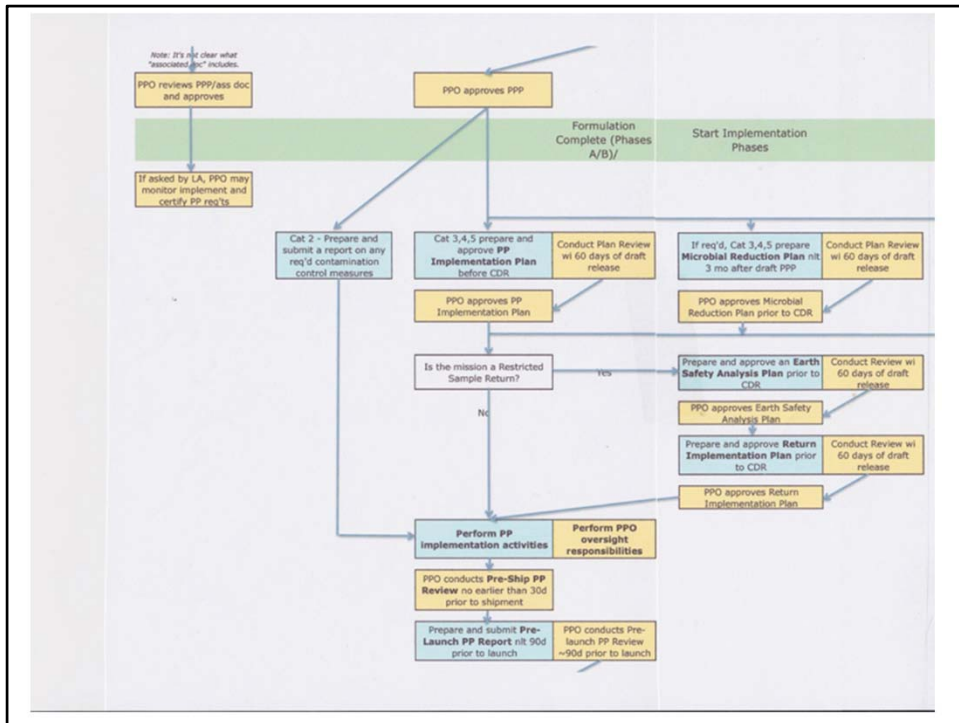| A_2 Mission Multiple	Launch Reported to NFSAM	Launch Concurrence/ Approval by	Launch Reported to OSTP	Required Level of Review and Reports	Approval/ Concurrence
$A_2 < 0.001$	Yes	NFSAM	no	Paragraph 6.3.3	Concurrence letter from NFSAM
$0.001 \leq A_2 < 10$	Yes	NFSAM	yes	Paragraph 6.3.4	Concurrence letter from NFSAM
$10 \leq A_2 < 500$	Yes	Chief, Safety and Mission Assurance	yes	Paragraph 6.3.5, Nuclear Safety Review	Approval letter from Chief, Safety and Mission Assurance
$500 \leq A_2 < 1,000$	Yes	NASA Administrator	yes	Paragraph 6.3.6, Safety Analysis Summary (SAS)	Approval letter from NASA Administrator
$1000 \leq A_2$	Yes	Executive Office of the President	yes	Paragraph 6.3.7, Safety Analysis Report	NASA Administrator requests approval via Director, OSTP

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Planetary Protection Policy
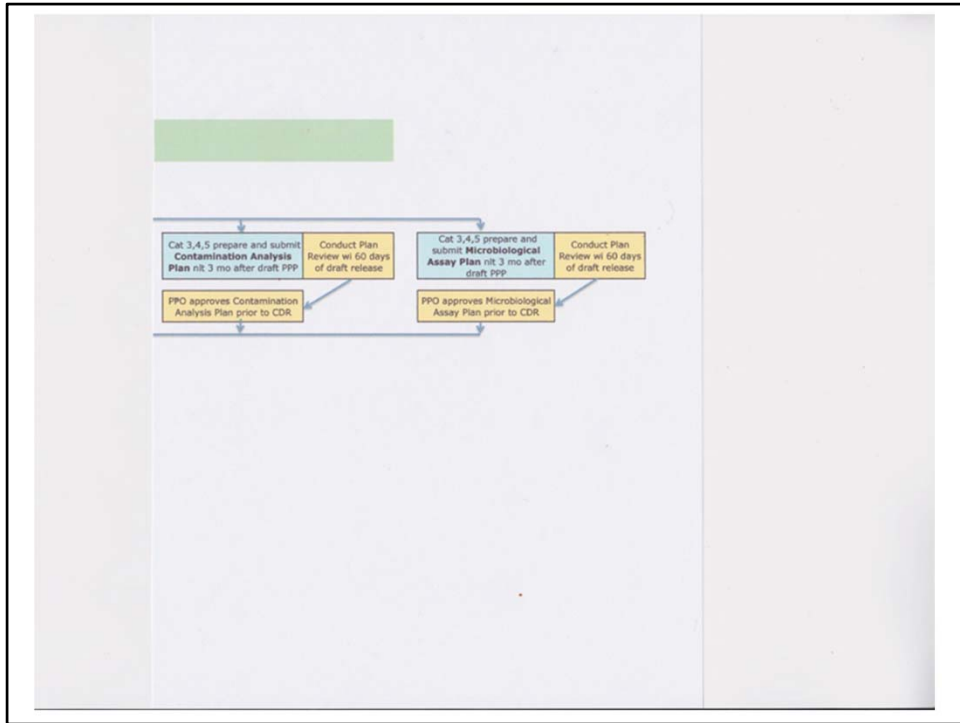
Important Changes to PP NPR in PP NID

- P.5 revised to clarify role of PPO:
  - "recommends approval or non-concur to the SMD AA for the final gate products identified in this document at Key Decision Points (KDPs)"
  - compliance with req'ts subject to verification by PPO who certifies to SMD AA prior to launch that all PP req'ts have been met.

- Section 1 added following language:
  - "Planetary Protection involves protecting the planet we are visiting and protecting the Earth from harmful organic or biological elements when we return samples or contaminated spacecraft or astronauts; and is the responsibility of the Planetary Protection Officer."
  - "Mission Science integrity is the responsibility of the science community, which involves maintaining cleanliness levels required to achieve the science investigation including when samples are returned to Earth."

- 1.3 Deviations
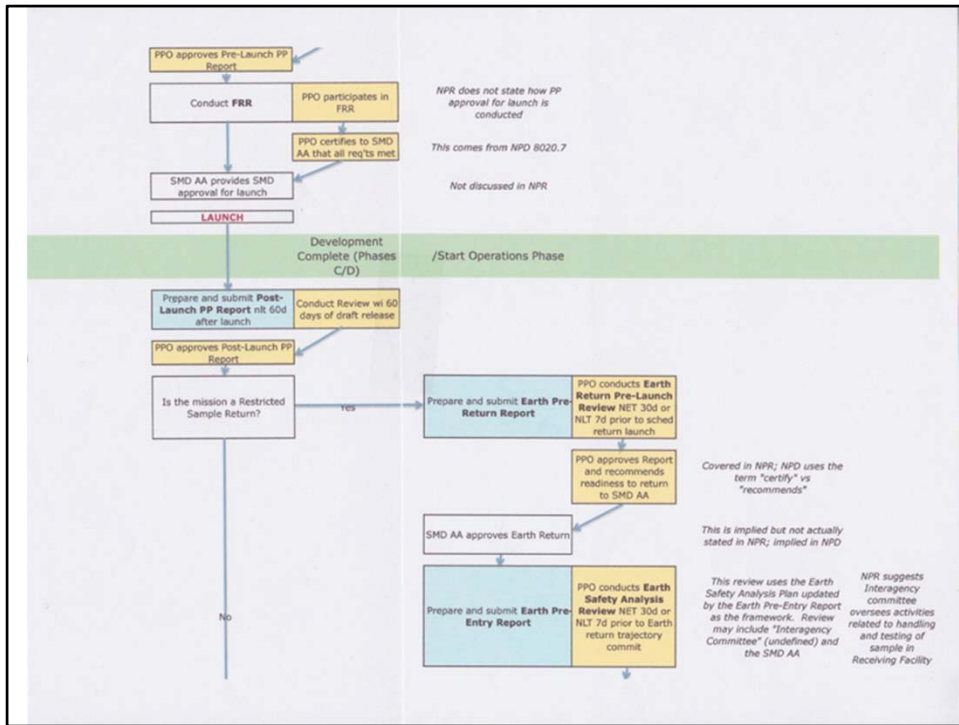 - Added waivers and SMD AA approves waivers and deviations with PPO concurrence.

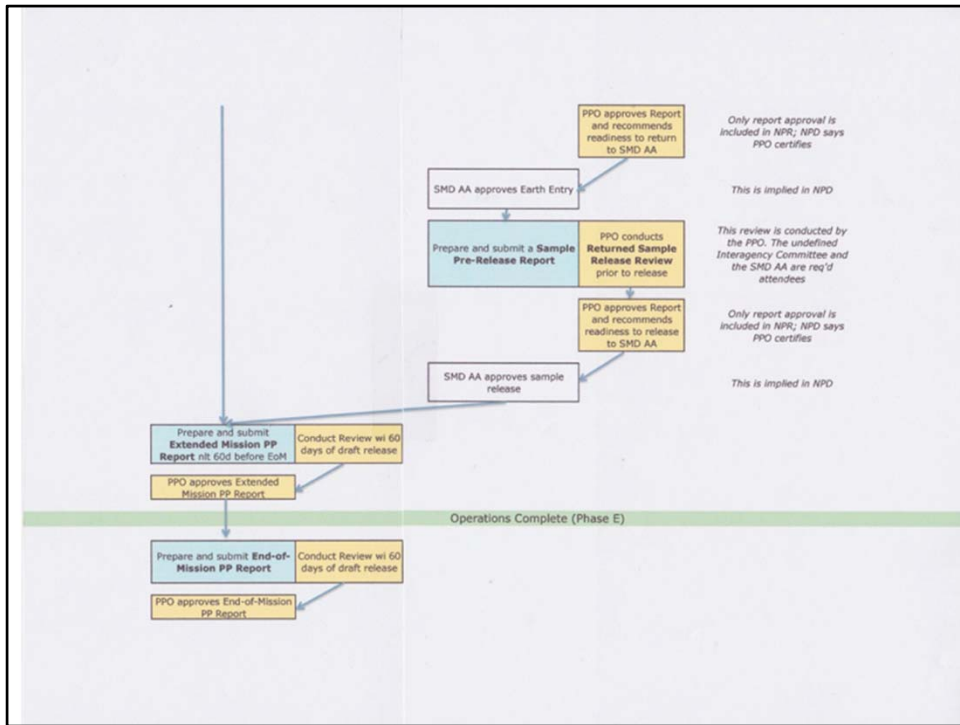18

Important Changes to PP NPR in PP NID

- **2.1 NASA Missions**
  - Categorization documented in PLRA
- **2.2 NASA Participation in non-NASA or non-US Missions**
  - NASA PPO removed from formal process except to provide preliminary guidance if requested by project
- **2.5 Schedules of Documentation and Review Requirements**
  - SMD AA is now document approval authority; PPO concurs
- **Section 2 in general**
  - Lots of inconsistencies have been introduced in the NID, but it looks like the same general documents and reviews are required.

PLANETARY PROTECTION (PP) PROCESS per NPR 8020.12D (D version used since current NPR rewrite started from this versi...

Decide to do mission to Planetary Body

NASA Mission or Non-NASA Mission?

Non-NASA Mission

PP cat & certification of compliance - Lead Agency (LA)

If launched in US, Lead Agency provides doc of PP compliance to NASA

Request **Prelim PP Categorization** from PPO

PPO provides prelim CAT

NPR DEVIATION PROCESS NOT SHOWN

LEG
PPO A
Project/mis
Other

Italicized t

Pre-Formulation Complete

Mission approved for Formation

Mission formally requests **PP Cat** from PPO

PPO determines **Mission PP Cat** (Mission Certification??)

Sample return

Note: term "certification" is used inconsistently - not sure what this means. Table 3 shows this as a document req't

PPO recommends Restricted or Unrestricted Earth return to SMD AA

SMD AA approves **Certification of Earth Return**

Restricted return

Unrestricted return

Certification of Unrestricted return nlt end of Phase A

Prepare **Parameter Specification Sheets** during Phase A

Review Parameter Spec Sheets

PPO approve Parameter Spec Sheets

NASA sponsored entity prepare PPP and associated doc and submit to PPO

Cat 1 - No further action req'd

Cat 2, 3, 4, & 5 prepare draft **Planetary Protection Plan (PPP)** by PDR. Plan req'ts vary by cat

PPP Review within 60 days of draft release

Top-level Issues with NASA PP Policy

- **Oversight role of PPO is inconsistent with how NASA manages and oversees its missions.**
  - This approach is not req'd by COSPAR Policy
  - PPO appears to be inserting itself into Project level activities, particularly with respect to requirements definition and flowdown
- **No conflict resolution path; PPO has been "judge, jury, and executioner"** (NID attempts to solve this)
  - **Inconsistent with NASA's governance model**
- **PP req'ts do not appear to be typical programmatic req'ts**
- PP policy, as written, is too convoluted to easily understand.
- PP policy appears to have overlapping documentation req'ts.
- Level of documentation and reviews req'd seem excessive.
- Approval process in NID seems to be inconsistent with way SMD manages and oversees its missions.
- Interagency Committee and its role is inadequately defined.

BACKUP

Engineering Technical Authority
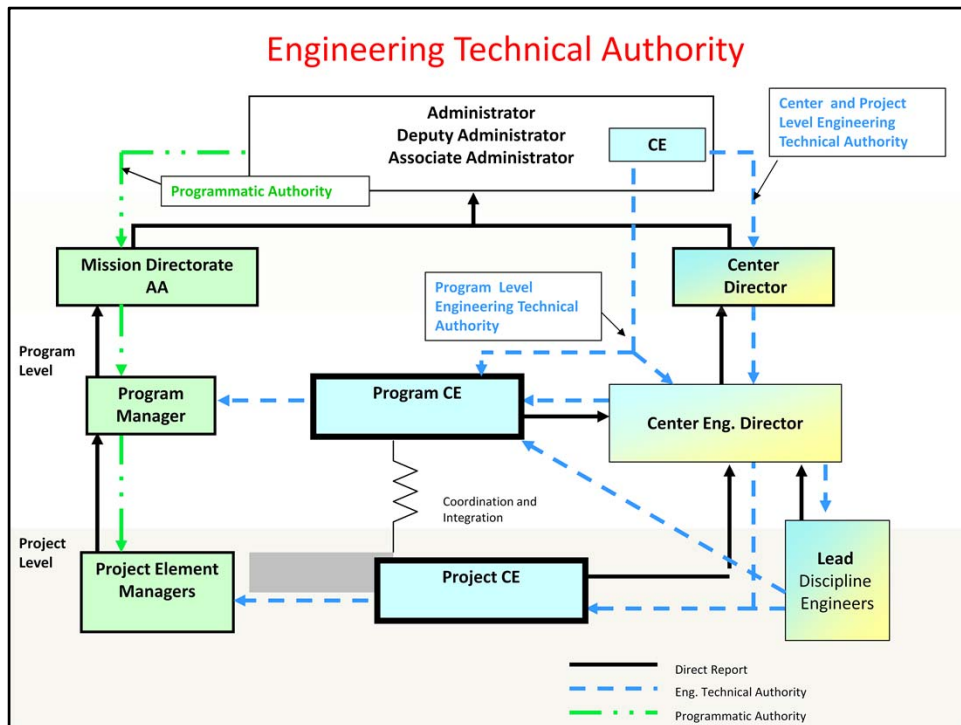
Points to note -
This is a generic presentation of Engineering Technical Authority flow. The specific structure at each Center is approved by the NASA CE.

Engineering Technical Authority originates with the Administrator who delegates specific responsibilities and authority to the NASA Chief Engineer.
Specific Engineering Technical Authority responsibilities are then delegated from the NASA Chief Engineer to the Center Director (or designee) for Center Institutional processes, **projects, and single project programs**.

For **other Programs** Engineering Technical Authority is delegated to the Engineering Director for **Program level** Technical Authority.
The Center delegates specific responsibilities and authorities to Project Chief Engineers and the Center Lead Discipline Engineers (or equivalent).

Why is the Technical Authority flow for programs different from projects? Why does Headquarters own level 2 (program level) requirements?
Answer
Multiple centers will be engaged in many programs to take full advantage of the Agency's human and facility resources. In this multi-center environment having the flow of Technical Authority by-pass the Center Director provides Headquarters the role of adjudicating differences between projects at different Centers. This avoids any concerns about a conflict of interest that might arise if the Center Director of the Host Center adjudicated differences between his/her Center and another Center.