Goddard Procedural Requirements (GPR) 7123.1B Update

Systems Engineering Seminar
May 6, 2014

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Code 599

Agenda

- Objectives of this Seminar
- Brief Introduction to NPR and GPR 7123.1
- Changes to NPR 7123.1 (A to B)
- Changes to GPR 7123.1 (A to B)
- Change Effects on Systems Engineering Management Plans (SEMP)
- Forward Plans for GPR 7123.1

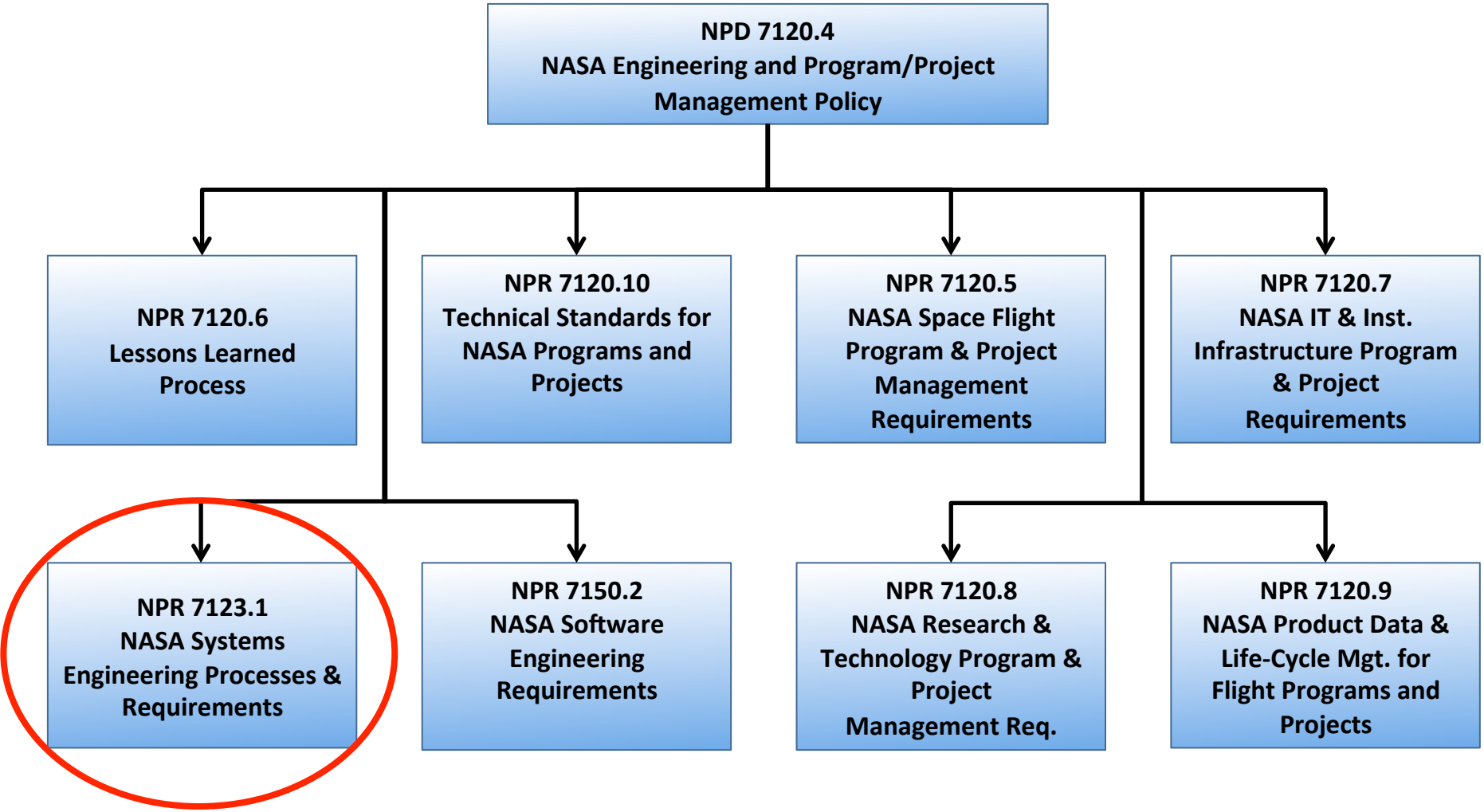
Objectives of this Seminar

- Rollout the Updated GPR 7123.1 (A to B) – GSFC Systems Engineering Requirements
- Highlight what drove the changes to the GPR
  - NPR 7123.1A to NPR 7123.1B
  - Continue Compliance with NPR 7123.1
  - GPR 7123.1 Requirement Consolidation
- Inform attendees how the changes impact GSFC Programs and Projects
- Highlight upcoming GDMS Release pf GPR Update for Review/ Input by GSFC Stakeholders

Brief Introduction to NPR 7123.1 and GPR 7123.1

NASA/GSFC Systems Engineering Standards

NASA Engineering Policy Overview



NPR 7123.1 to GPR 7123.1

NPR 7123.1 – NASA Procedural Requirements

- Contained Core SE Requirements for Field Centers to follow
- Appendix C contains Process Associated "Best Practices"

GPR 7123.1 – GSFC Procedural Requirements

- Tailored for GSFC methodology of SE
- Compliance matrix used to demonstrate flow-down

Most NASA Centers developed their own "PR"'s in response to the NPR during the .1A era

COMPLIANCE TO THE NPR 7123.1 REQUIREMENTS IS MANDATORY FOR NASA PROGRAMS/PROJECTS

How the NPR 7123.1A was Infused at GSFC

The Implementation Plan was used to track NPR 7123.1 infusion at Centers

The Center Survey was used to track Appendix C best practice use at Centers

NPR 7123.1A
Released 3/07

Implementation Plan (H-1)
57 Core Reqts
(Rev -) Submitted 7/07
Updated 8/10

Center Survey (H-2)
108 "Best Practices"
Submitted 4/09

Compliance Matrix

Traceability Matrix

GPR 7123.1A
Issued 10/08
Updated 08/10

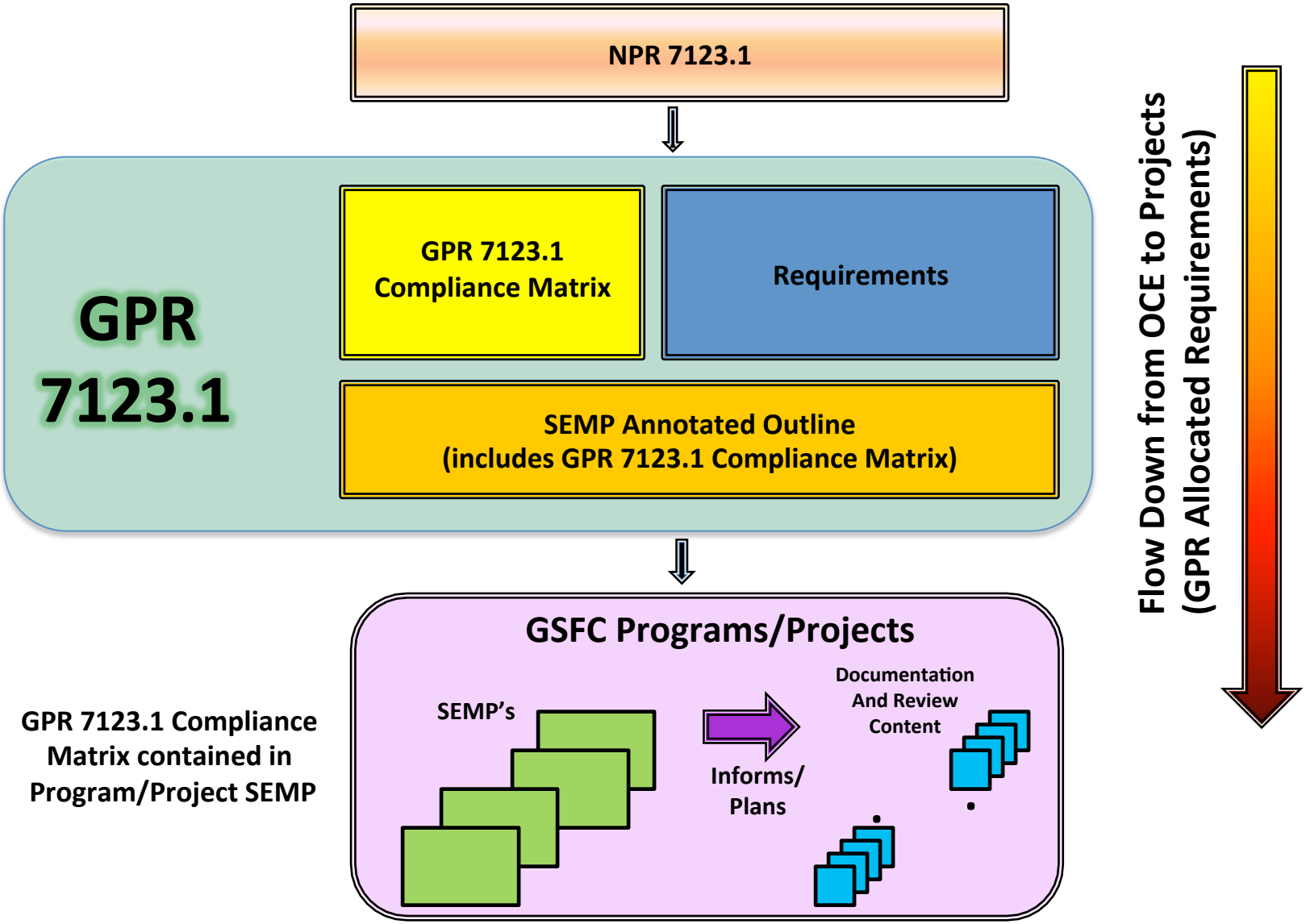
GPG's

GSFC-STD-1001

Other GPR's

GSFC Accomplished Complete Compliance to NPR 7123.1A in 2009 and was confirmed by an audit performed in October 2010

How the NPR 7123.1 Flows Down to GSFC Projects



GPR 7123.1 Compliance Matrix contained in Program/Project SEMP

GPR 7123.1 Contents

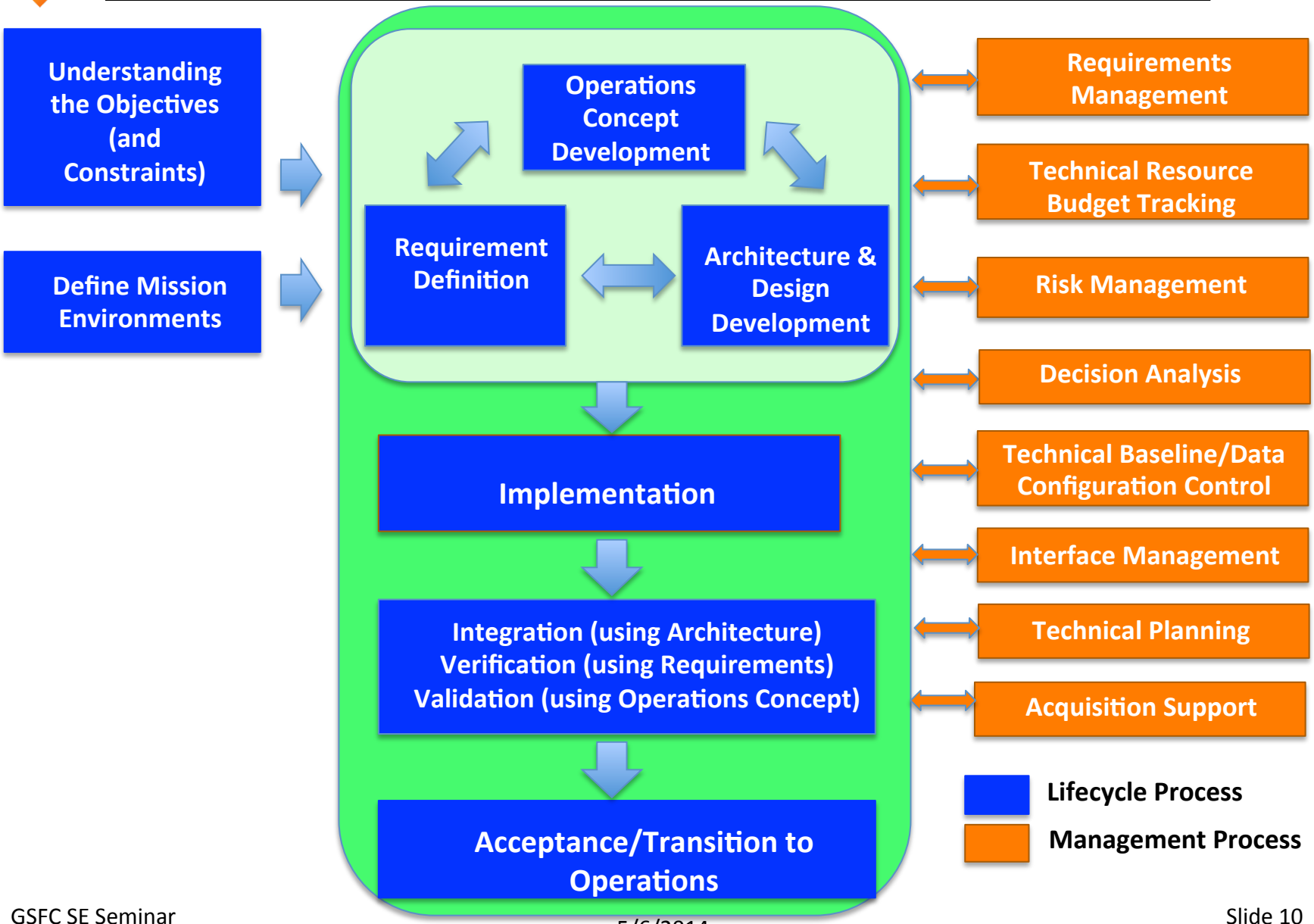
GPR 7123.1 Provides Definitions, Guidelines and Process Requirements for Systems Engineering Activities at GSFC:

- Roles and Responsibilities
- Systems Engineering Lifecycle
- Systems Engineering Management
- Key Systems Engineering Functions (Lifecycle and Management Processes)
- Systems Engineering Reviews and Deliverables

The GPR also includes the following key appendices:

- NPR Compliance Matrix
- Annotated SEMP Outline including the GPR Compliance Matrix

GPR 7123.1 Key SE Functions in a Nutshell



GPR 7123.1 Key SE Function Products

Key Function (Processes)	Where Typically Documented	When Baselined
4.1.1 Understanding the Objectives	Level I Requirements Document	Phase A
4.1.2 Mission Environments	Environmental Test Plan, Orbit Debris Analysis	Phase A
4.1.3 Operations Concept Development	Concept of Operations Document, Operations Plan	Phase A
4.1.4 Requirements Identification	Level II Requirements Document, Level N Requirements Documents	Phase A
4.1.5 Architecture & Design Development	Architecture Description Document, Design Documentation, System Drawings	Phase A/Phase B
4.1.6 Product Implementation	Subsystem Descriptions, As-built Documentation	Phase C
4.1.7 Integration	Integration Plan, Integration Procedures	Phase C
4.1.8 Verification	Verification Plan, RVTM	Phase C
4.1.9 Validation	Validation Plan, RVTM	Phase C
4.1.10 Product Acceptance & Transition	Acceptance Plan, Transition Plan	Phase C
4.2.1 Requirements Management	Requirements Management Plan (SEMP), Reqts Database	Phase A
4.2.2 Interface Management	IRD's, IDD's, ICD's	Phase A/B
4.2.3 Technical Planning	SEMP	Phase A
4.2.4 Technical Resource Budget Tracking	Resource Budgets (MSR)	Phase A
4.2.5 Configuration Management and Data Storage	CM Plan, CM'd Products, Technical Data Products	Phase A
4.2.6 Risk Management	Risk Mgmt Plan, Risk Database (MSR)	Phase A
4.2.7 Decision Analysis	Trade Study Reports, SEMP (Major Trades)	As needed
4.2.8 Acquisition Support	SOW, Contract	Pre-Phase A/Phase A

NPR 7123.1 to GPR 7123.1 Process Mapping

NPR 7123.1	GPR 7123.1
1. Stakeholder Expectations	4.1.1 Understanding the Objectives 4.1.2 Mission Environments 4.1.3 Operations Concept Development
2. Requirements Definition	4.1.4 Requirements Identification
3. Logical Decomposition	4.1.5 Architecture and Design Development
4. Design Solution	4.1.5 Architecture and Design Development
5. Product Implementation	4.1.6 Product Implementation 4.2.8 Acquisition Support
6. Product Integration	4.1.7 Integration
7. Product Verification	4.1.8 Verification
8. Product Validation	4.1.9 Verification
9. Product Transition	4.1.10 Product Acceptance and Transition
10. Planning	4.2.3 Technical Planning
11. Requirements Mgmt	4.2.1 Requirements Management
12. Interface Mgmt	4.2.2 Interface Management
13. Risk Mgmt	4.2.6 Risk Management
14. Configuration Mgmt	4.2.5 Configuration Management and Data Storage
15. Technical Data Mgmt	4.2.5 Configuration Management and Data Storage
16. Technical Assessment	4.2.4 Technical Resource Tracking 4.2.3 Technical Planning Milestone Reviews
17. Decision Analysis	4.2.7 Decision Analysis

Why was the GPR 7123.1 Updated?

- The NPR 7123.1A expired in March 2012; NPR 7123.1B was released in May 2013
- The NPR 7120.5 was updated; the two NPR's work together closely
  - The OCE PM and SE teams cross-pollenated to develop the NPR's in concert
  - Review definition and products were consolidated into the NPR 7120.5E
  - NPR 7120.5E version was baselined Aug 2012, ahead of NPR 7123.1B
- GPR 7123.1A demonstrated GSFC full compliance with NPR 7123.1A
- NPR 7123.1A was rolled out to GSFC Directorates in July 2013
- In order to maintain compliance, the GPR needed to be updated

By the Numbers:

NPR 7123.1A Requirement Count			57	GPR 7123.1A Requirement Count			106
Deleted		-23		Deleted		14	
No Change/Minor Change	31			No Change	82		
Rewrite	3			Rewrite	10		
New		+30		New		0	
NPR 7123.1B Requirement Count			64	GPR 7123.1B Requirement Count			92

Bottom Line for GPR: 14 Requirements Deleted, 10 Requirements Edited .. 24 Requirement Changes Made

NPR 7123.1 Changes (A to B)

Summary of Changes - NPR 7123.1 A to B (1/2)

Requirement Changes

- Address consistency with other SE and Program and Project NPRs
- Deleted or modified duplicate requirements
- Clarified Roles and Responsibilities
  - Designated Governing Authority
  - Technical Team
- Changed organization and use of compliance matrices (H-1 and H-2)
- Removed software development requirements
  - Refer instead to NPR 7150.2
- Changed approach to Life-cycle and Technical Review requirements
  - Refer instead to Governing NPR for Life Cycle Reviews
  - Added specific product requirements per review

Summary of Changes - NPR 7123.1 A to B (2/2)

Non-Requirement Changes

- Added unique identifier (e.g., **SE-01**) for each requirement in text to facilitate reference in compliance matrices

- Made terminology changes for consistency with NPR 7120.5E
  - e.g., clarify definition of "Tailoring"

- Updated / Deleted Appendices, e.g.,
  - updated review entry / exit criteria
  - deleted dedicated tailoring appendix, etc.

H-1 and H-2 Purposing in NPR 7123.1A/B

2007-2012 Era: NPR 7123.1A
Objective: Implement NPR at Center level, prepare Center documentation for implementation at the Program/Project Level and begin infusion

NPR 7123.1A

57 Mandatory Requirements

SE- 05 → Required Submission to OCE: H-1 "Center Implementation Plan"
Described Center Plan to implement NPR 7123.1A; contained compliance matrix for Center implementation of entire 57 mandatory requirement set

SE - 08 → H-2 "Center Survey"
Self-Assessment of Center Use of Appendix C "Best Practices" which were not mandatory

GSFC was compliant with both the H-1 (2008) and H-2 (2009); was independently confirmed by external review and during the OCE Survey in 2010

2013- 2018 Era: NPR 7123.1B
Objective: Maintain Implementation at Center Level, Implement at Program/Project Level

NPR 7123.1B

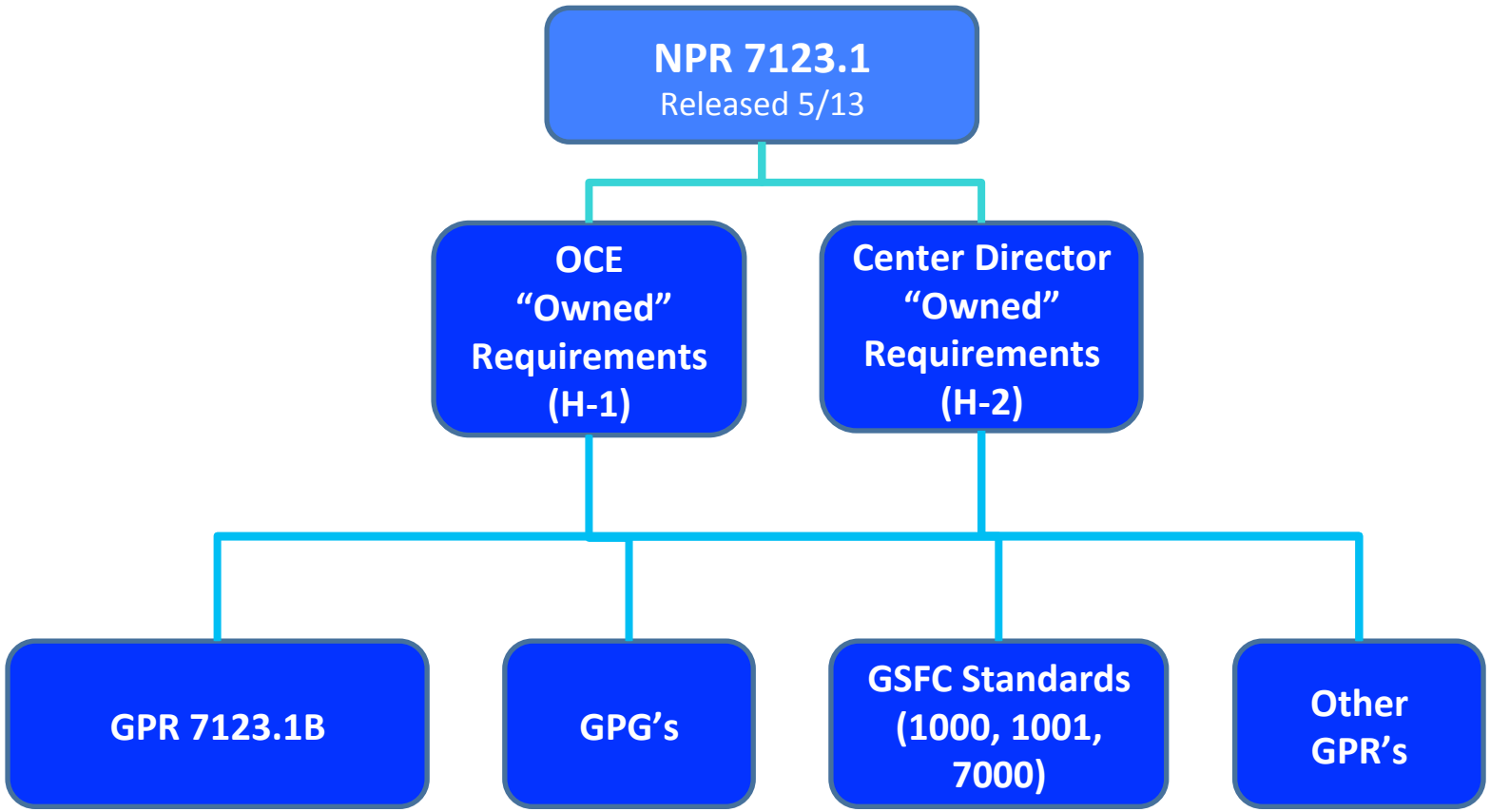
64 Mandatory Requirements

SE- 04 → Required Submission to OCE: H-1 "Center Level Compliance Matrix"
Compliance Matrix for 21 of the NPR 7123.1B requirements (17 of which are process definition) that are implemented at the Center/DGA Level

SE - 05 → Required SEMP Element: H-2 "Program/Project Level Compliance Matrix"
Compliance Matrix for 43 of the NPR 7123.1B requirements that are implemented at the Program/Project Level (projects already performing the bulk of the reqts; contained in SEMP)

GPR 7123.1B continues compliance with NPR 7123.1B

How the NPR 7123.1 is Infused at GSFC



GSFC Continues Compliance to NPR 7123.1 with GPR 7123.1 Update as indicated in Compliance Matrices

GSFC Standards

- **NASA GSFC-STD-1000 - Rules for the Design, Development, Verification, and Operation of Flight systems (aka "Golden Rules")**

- **NASA GSFC-STD-1001 - Criteria for Flight and Flight Support Systems Lifecycle Reviews**

- **NASA GSFC-STD-7000 - General Environmental Verification Standard (GEVS) for GSFC Flight Programs and Projects**

These standards are used by Systems Engineering for establishing technical solutions, review planning and test/evaluation - are used to demonstrate GSFC compliance with several NPR 7123.1 requirements

GPR 7123.1 Changes (A to B)

Project System Review Plan

Insert to <u>SYSTEMS ENGINEERING REVIEWS AND DELIVERABLES:</u>

"The Mission Systems Engineer works with the Project Manager and the GSFC Systems Review Office to define the series of system reviews required for the mission. The results of this effort are captured in the Project Systems Review plan, which could be a standalone document or contained in the Project Management Plan"

The Systems Review Plan (SRP) captures agreements between Code 300, 400 and 500 for planned project reviews. GSFC-STD-1001 provides guidance for the contents of the SRP. The SRP is tailored based on Mission Class, etc.

Technical Performance Measurement Definition

Insert to <u>Technical Resource Budget Tracking:</u>

"Technical performance measures (TPM's) are defined as the set of critical or key performance parameters that are monitored by comparing the current actual achievement of the parameters with that anticipated at the current time and on future dates. These measures are used to confirm progress and identify deficiencies that might jeopardize meeting a system requirement. Assessed parameter values that fall outside an expected range around the anticipated values indicate a need for evaluation and corrective action. Technical performance measures are typically selected from the defined set of Measures of Performance (MOPs)."

Designated Governing Authority (DGA) Definition

Edit to Definitions Section:

"The Center Director or the person that has been designated by the Center Director to ensure the appropriate level of technical management oversight. Such designation is made from the technical line so that independence between programmatic and technical authority is maintained. "

Changes to NPR 7123.1/Effect on GSFC SE Practices – Technical Performance Measurements (2/2)

- GSFC-STD-1001 Criteria for Flight and Flight Support Systems Lifecycle Reviews
- GPR 8700.4H Goddard Systems Reviews
- Monthly Status Reviews (MSR)

Area	NPR Change	Corresponding GPR Change	GPR Requirement From	GPR Requirement To	Effect on SE Practices
Technical Performance Measures (TPMs)	Added Mass (Flight) and Power (Powered Systems) to TPM Definition	Edited Resource Tracking Requirement to explicitly include these items	R-82: Each project shall identify the mission resources to be allocated and tracked.	R-82: Each project shall identify the mission technical performance measures to be allocated, tracked and reported at regular intervals; for flight segments, at a minimum these include mass for hardware elements and power for powered elements.	Already in Practice at GSFC via MSR, System Reviews, and GSFC-STD-1001 – No changes Required to SE Practices
	Added requirements to Track/Report TPM's	No change Required	N/A	N/A	
	Added requirement to Track/Report Action Items from Reviews	No change Required	N/A	N/A	

Changes to NPR 7123.1/Effect on GSFC SE Practices – Reviews/Deliverables

Area	NPR Change	Corresponding GPR Change	GPR Requirement From	GPR Requirement To	Effect on SE Practices
Lifecycle Reviews	Removed list of Lifecycle Reviews and Reference to Documentation List	Reworded requirements to use System Review Plan and GSFC-STD-1001	R-102: The monitoring function for traditional FS&GS projects shall be accomplished using the following required minimum set of technical reviews: Mission Concept Review (MCR), System Requirements Review (SRR), ...	R-102: The technical team shall conduct the life-cycle and technical reviews in accordance with the Project System Review plan.	Already in Practice at GSFC via GSFC-STD-1001 – No changes Required to SE Practices
			R-103: In addition, the minimum set of mission reviews shall include GSFC specific technical reviews such as the Mission Operations Review (MOR), ...	Deleted	
	Added Individual Requirements per Review/Corresponding Documentation		R-106: The technical team shall address the entrance and success criteria listed in GSFC-STD-1001 and in Appendix G of NPR 7123.1 for applicability to the respective reviews.	R-106: For each review defined in the Project System Review plan, the technical team shall provide the list of technical products defined in GSFC-STD-1001	

Changes to NPR 7123.1/Effect on GSFC SE Practices – SEMP/DGA

Area	NPR Change	Corresponding GPR Change	GPR Requirement From	GPR Requirement To	Effect on SE Practices
SEMP Updates	Removed Requirement for SEMP Updates at each milestone review	Deleted Requirement	R-9: The technical team shall baseline the SEMP prior to the completeion of Phase A and update at each major milestone review or its equivalent. The DGA or designate shall review and approve or disapprove the SEMP at each major milestone review or its equivalent.	Reallocated Requirement to Next item	SEMP updates are not required at milestone reviews, but should be updated as needed
Designated Governing Authority (DGA) Role Clarification	Allocates functions to DGA: approve the SEMP, waiver authorizations, and other key technical documents	Split the functions required into 2 roles using GSFC practices; delegated technical document review to Project Lead SE	Reallocated R-9	R-9: The Project Lead Systems Engineer shall review and approve key technical documents and any associated waivers.	
			R-7: The Designated Governing Authority (DGA) or his/her designate shall have responsibility to approve or disapprove any requirement of this document that is either tailored or waived.	R-7: The DGA shall approve the SEMP and any GPR 7123.1B associated waivers.	

Changes to NPR 7123.1/Effect on GSFC SE Practices – SDMP Alignment/Project Definition

Area	NPR Change	Corresponding GPR Change	GPR Requirement From	GPR Requirement To	Effect on SE Practices
Software Development and Management Plan Alignment	Removed Requirements due to NPR 7150.2 at same level as 7123.1	Deleted Requirements	R-3: For systems that contain software, the mission team shall ensure that software acquired or developed internally within NASA complies with NPD 2820.1, NASA Software Policy, and NPR 7150.2, NASA Software Engineering Requirements.	DELETED	None; SE team includes SW SE at GSFC
			R-81: Software Development and Management Plans shall be validated to the SEMP for consistency.	DELETED	
Multi-Center Program/Projects	Downgraded from requirement to suggestion	Used same approach	R-4: For programs and projects involving more than one Center, the lead organization shall develop documentation to describe the hierarchy and reconciliation of center plans implementing NPR 7123.1.	DELETED	None; SEMP outline includes option for including this as needed.

Additional Changes to GPR 7123.1

Document Updates/Continuum For SE Lifecycle

Edited Table 2 to remove Delivery Schedule per Phase – Defined in NPR 7120.5E

Key Function	Where Typically Documented	Pre-Phase A Concept Studies	Phase A Preliminary Analysis	Phase B Definition	Phase C Design	Phase D Development	Phase E / F Operations
4.1.1 Understanding the Objectives	Level I Requirements Document	Concept	Baseline	Complete (Note 1)	Track Changes	Track Changes	Track Changes
4.1.2 Mission Environments	Environmental Test Plan Orbit Debris Analysis	Initial	Baseline	Complete	Track Changes	Track Changes	Track Changes
4.1.3 Operations Concept Development	Concept of Operations Document Operations Plan	Concept	Baseline	Complete	Track Changes	Track Changes	Track Changes
4.1.4 Requirements Identification	Level II Requirements Document Level N Requirements Documents	Concept	Top Level Baseline	Complete	Track Changes	Track Changes	Track Changes
4.1.5 Architecture & Design Development	Architecture Description Document Design Documentation System Drawings	Concept	Baseline	Complete	Track Changes	Track Changes	Track Changes
4.1.6 Product Implementation	Subsystem Descriptions As-built Documentation		Concept	Develop Plans	Develop Plans	Complete	
4.1.7 Integration	Integration Plan Integration Procedures	Concept	Concept	Initial	Develop Plans	Complete	
4.1.8 Verification	Verification Plan RVTM	Concept	Initial	Assign Method	Develop Plans	Complete	
4.1.9 Validation	Validation Plan RVTM	Concept	Initial	Assign Method	Develop Plans	Complete	
4.1.10 Product Acceptance & Transition	Acceptance Plan Transition Plan	Concept	Concept	Initial	Baseline	Track Changes	Complete
4.2.1 Requirements Management	Requirements Management Plan (SEMP) Reqts Database	Concept	Baseline	Complete	Track Changes	Track Changes	
4.2.2 Interface Management	IRD's IDD's ICD's	Concept	Initial (Note 2)	Baseline	Complete	Track Changes	
4.2.3 Technical Planning	SEMP	Concept	Initial	Baseline	Complete	Track Changes	
4.2.4 Technical Resource Budget Tracking	Resource Budgets (MSR)	Concept	Initial	Baseline	Track Changes	Track Changes	Track Changes
4.2.5 Configuration Management and Data Storage	CM Plan CM'd Products Technical Data Products	Informal CM	Control Level 1 Requirements	Start Formal CM	Track Changes	Track Changes	Track Changes
4.2.6 Risk Management	Risk Mgmt Plan Risk Database (MSR)	Estimate	Draft FTA, RBD	Preliminary FMEA and FTA, RBD	Baseline FTA, FMEA, RBD, PRA	Update Changes	Update Changes
4.2.7 Decision Analysis	Trade Study Reports SEMP (Major Trades)	Apply as Needed					
4.2.8 Acquisition Support	SOW, Contract	Develop SOW	Evaluate Proposal(s)	Technical Oversight & Reviews			
5.0 System Milestone Reviews (Note3)	Review Packages	MCR	SRR, MDR	SCR, PDR,	CDR, SIR	MOR, TRR (PER), FOR, PSR, FRR, ORR	PLAR, CERR, DR

Removed Delivery Schedule (defined in NPR 7120.5E

GPR 7123.1 Requirement Consolidation (1 of 4)

R-06, 08, 75 into R-08

- **R-06:** The Product Manager and the Lead Systems Engineer shall develop the plan for the systems engineering effort and establish a systems engineering team along with roles and responsibilities.
- **R-08:** The results of Technical Planning, including the associated roles and responsibilities, are captured in the SEMP (Section 4.2.3).
- **R-75:** The Product Manager and the Lead Systems Engineer shall prepare a SEMP that addresses the requirements of this GPR and describes What, When, Where, by Whom, and How each are to be implemented.

NEW R-08: The technical team shall capture the results of the technical planning process in the SEMP as defined in Appendix D.

Rationale for change: Consolidate for more succinct, single requirement

GPR 7123.1 Requirement Consolidation (2 of 4)

R-29, 39, 70, 93 into R-93

- **R-29:** The outcome and decisions for key operations concept trade studies and optimizations shall be documented.
- **R-39:** The outcome and decisions of key architecture and design trade studies and optimizations shall be documented. (Section 4.2.7)
- **R-70:** The outcome and decisions for key requirements trade studies and optimizations shall be documented, (Section 5). Trade studies and analysis are used to refine the requirements along with the Operations Concept and the Architecture and Design to meet the Mission Design Requirements including cost and schedule.
- R-93: The Technical team shall identify, track, document the results of key trade studies and integrate the results into mission products.

NEW R-93: The Technical team shall identify, track, and document the results of key trade studies.

Rationale for change: Consolidate for more succinct, single requirement

GPR 7123.1 Requirement Consolidation (3 of 4)

R-30, 57, 58, 60 into R-57

- **R-30:** The Operations Concept shall be validated to the Mission System (Level 2) Requirements.
- **R-57:** The Operations Concept shall be validated to assure that the operation of the system will meet Mission Objectives by achieving the Measurement Concept and accommodating the Payload Concept. The Requirements are validated to the Mission Validation Basis.
- **R-58:** Requirements shall be validated to assure that the system will meet the Mission Objectives, be capable of performing the Measurement Concept, accommodate the Payload Concept, and operate as defined in the Operations Concept
- **R-60:** The Architecture and Design shall be validated to assure that the operation of the system will meet Mission Objectives by implementing the functions and achieving the performance needed to achieve the Measurement Concept and accommodate the Payload Concept.

NEW R-57: The Technical team shall validate the end product by using the Operations Concept to ensure the system meets Stakeholder Expectations.

Rationale for change: Consolidate for more succinct, single requirement

GPR 7123.1 Requirement Consolidation (4 of 4)

R-44 and R-62 into R-62

- **R-44:** Acceptance criteria shall be developed for all product elements.
- **R-62**: Acceptance criteria shall be developed for system end products.

R-62: Acceptance criteria shall be developed for system end products. (no change to R-62)

Rationale for change: Consolidate for more succinct, single requirement

Miscellaneous Requirement Changes (1/2)

R-73 Interface Control Documents

FROM:

- **R-73:** The project team shall decide which ICDs are necessary, given the complexity, organization structure, and participants.

TO:

- **R-73: The Project Lead Systems Engineer shall identify all system interfaces and determine ICDs needed for project implementation.**

Rationale:

- **Old requirement did not cover NPR requirement entirely; new wording also clarifies decision authority on ICD identification**

R-2 Project Exclusion - Deleted

- R-2: Projects specifically excluded from the application of this GPR are Basic and Applied Research (BAR), Advanced Technology Development (ATD), Institutional Projects (IP), and Institutional IT Projects.

Miscellaneous Changes Included (2/2)

R-10

FROM:

- **R-10:** Each Project shall work with the stakeholders and the appropriate Enterprise Office at NASA Headquarters to prepare a set of Mission (Level 1) Requirements that form the validation basis for the Mission System (Level 2) Requirements.

TO:

- **R-10:** Each Project shall work with the stakeholders and the appropriate Mission Directorate at NASA Headquarters to prepare a set of Mission (Level 1) Requirements that form the validation basis for the Mission System (Level 2) Requirements.

Rationale:

- **NASA Organizational Change**

GPR 7123.1 Requirement Change Matrix (1/3)

Reqt #	FROM	TO	Rationale for Change
R-2	Projects specifically excluded from the application of this GPR are Basic and Applied Research (BAR), Advanced Technology Development (ATD), Institutional Projects (IP), and Institutional IT Projects.	DELETED	Extraneous Requirement
R-3	For systems that contain software, the mission team shall ensure that software acquired or developed internally within NASA complies with NPD 2820.1, NASA Software Policy, and NPR 7150.2, NASA Software Engineering Requirements.	DELETED	NPR Parent Reqt Deleted
R-4	For programs and projects involving more than one Center, the lead organization shall develop documentation to describe the hierarchy and reconciliation of center plans implementing NPR 7123.1.	DELETED	NPR Parent Reqt Deleted
R-6	The Product Manager and the Lead Systems Engineer shall develop the plan for the systems engineering effort and establish a systems engineering team along with roles and responsibilities.	DELETED	Consolidate R-06, 08, 75 into R-08
R-7	The Designated Governing Authority (DGA) or his/her designate shall have responsibility to approve or disapprove any requirement of this document that is either tailored or waived.	The DGA shall approve the SEMP and any GPR 7123.1B associated waivers.	NPR Reqt Change
R-8	The results of Technical Planning, including the associated roles and responsibilities, are captured in the SEMP (Section 4.2.3).	The technical team shall capture the results of the technical planning process in the SEMP as defined in Appendix D.	Consolidate R-06, 08 ,75 (reworded to absorb all 3)
R-9	The technical team shall baseline the SEMP prior to the completeion of Phase A and update at each major milestone review or its equivalent. The DGA or designate shall review and approve or disapprove the SEMP at each major milestone review or its equivalent.	The Project Lead Systems Engineer shall review and approve key technical documents and any associated waivers.	NPR Reqt Change
R-10	Each Project shall work with the stakeholders and the appropriate Enterprise Office at NASA Headquarters to prepare a set of Mission (Level 1) Requirements that form the validation basis for the Mission System (Level 2) Requirements.	Each Project shall work with the stakeholders and the appropriate Mission Directorate at NASA Headquarters to prepare a set of Mission (Level 1) Requirements that form the validation basis for the Mission System (Level 2) Requirements.	NASA Organization Redefinition
R-29	The outcome and decisions for key operations concept trade studies and optimizations shall be documented.	DELETED	Consolidate R-29, 39, 70, 93 into R-93

GPR 7123.1 Requirement Change Matrix (2/3)

Reqt #	FROM	TO	Rationale for Change
R-30	The Technical team shall validate the end product by using the Operations Concept to ensure the system meets Stakeholder Expectations	DELETED	Consoiidate R-30, 57, 58, 60 into R-57
R-39	The outcome and decisions of key architecture and design trade studies and optimizations shall be documented. (Section 4.2.7)	DELETED	Consolidate R-29, 39, 70, 93 into R-93
R-44	Acceptance criteria shall be developed for all product elements.	DELETED	Consolidate R-44, 62 into R-62 (no reword necessary on R-62)
R-57	The Operations Concept shall be validated to assure that the operation of the system will meet Mission Objectives by achieving the Measurement Concept and accommodating the Payload Concept. The Requirements are validated to the Mission Validation Basis.	The Technical team shall validate the end product by using the Operations Concept to ensure the system meets Stakeholder Expectations	Consoiidate R-30, 57, 58, 60 - reword for consolidation
R-58	Requirements shall be validated to assure that the system will meet the Mission Objectives, be capable of performing the Measurement Concept, accommodate the Payload Concept, and operate as defined in the Operations Concept.	DELETED	Consoiidate R-30, 57, 58, 60 into R-57
R-60	The Architecture and Design shall be validated to assure that the operation of the system will meet Mission Objectives by implementing the functions and achieving the performance needed to achieve the Measurement Concept and accommodate the Payload Concept.	DELETED	Consoiidate R-30, 57, 58, 60 into R-57
R-70	The outcome and decisions for key requirements trade studies and optimizations shall be documented, (Section 5). Trade studies and analysis are used to refine the requirements along with the Operations Concept and the Architecture and Design to meet the Mission Design Requirements including cost and schedule.	DELETED	Consolidate R-29, 39, 70, 93 into R-93
R-73	The project team shall decide which ICDs are necessary, given the complexity, organization structure, and participants.	The Project Lead Systems Engineer shall identify all system interfaces and determine ICDs needed for project implementation.	Reword to meet NPR Requirement
R-75	The Product Manager and the Lead Systems Engineer shall prepare a SEMP that addresses the requirements of this GPR and describes What, When, Where, by Whom, and How each are to be implemented.	DELETED	Consolidate R-06, 08, 75 into R-08

GPR 7123.1 Requirement Change Matrix (3/3)

Reqt #	FROM	TO	Rationale for Change
R-81	Software Development and Management Plans shall be validated to the SEMP for consistency.	DELETED	NPR Parent Reqt Deleted
R-82	Each project shall identify the mission resources to be allocated and tracked.	Each project shall identify the mission technical performance measures to be allocated, tracked and reported at regular intervals. For flight segments, at a minimum these include mass for hardware elements and power for powered elements.	Reword to meet NPR Requirement
R-93	The Technical team shall identify, track, document the results of key trade studies and integrate the results into mission products.	The Technical team shall identify, track, and document the results of key trade studies.	Consolidate R-29, 39, 93 (reworded to absorb all 3)
R-102	The monitoring function for traditional FS&GS projects shall be accomplished using the following required minimum set of technical reviews: Mission Concept Review (MCR), System Requirements Review (SRR), System Definition Review (SDR) and/or Mission Definition Review (MDR), Preliminary Design Review (PDR), Critical Design Review (CDR), Systems Integration Review (SIR), Test Readiness Review (TRR), System Acceptance Review (SAR)/Element Pre-Ship Review (PSR), Observatory Pre-Ship Review (PSR), Operational Readiness Review (ORR) and/or Mission Readiness Review (MRR), Flight Readiness Review (FRR), Operational Acceptance Review (OAR), Post-Launch Assessment Review (PLAR) and Decommissioning Review (DR).	The technical team shall conduct the life-cycle and technical reviews in accordance with the Project System Review plan.	Align with NPR Approach to reviews
R-103	In addition, the minimum set of mission reviews shall include GSFC specific technical reviews such as the Mission Operations Review (MOR), Pre-Environmental Review (PER), Flight Operations Review (FOR), Launch Readiness Review (LRR), Critical Event Readiness Review (CERR), Safety and Mission Success Review (SMSR), and Mission Readiness Brief (MRB)/MRR that will be employed by the robotic mission projects as shown in Figures 2, 3 and 4 and Table 1 (Key Function 4.10 & Note 3).	DELETED	Align with NPR Approach to reviews - reqt unnecessary
R-106	The technical team shall address the entrance and success criteria listed in GSFC-STD-1001 and in Appendix G of NPR 7123.1 for applicability to the respective reviews.	For each review defined in the Project System Review plan, the technical team shall provide the list of technical products defined in GSFC-STD-1001	Align with NPR Approach to reviews

Effects of GPR Changes on System Engineering Management Plans

Brief SEMP Introduction

- The Systems Engineering Management Plan is a key communication tool for the technical team. A written plan keeps the team on the same page and moving in the same direction.
- The SEMP captures agreements between stakeholders, establishes system boundaries, and provides roles and responsibilities within the technical team.
- An effective SEMP ultimately increases productivity by encapsulating this information as a project reference point.
- Regular updates to the SEMP keep the team informed as process definitions mature, are deployed and modified as needed.

Appendix D of the GPR 7123.1 contains the Annotated SEMP Outline – and contains recursive numbering of the main document.

What Changed in SEMP's ? (1/2)

- **SEMP Baseline/Update Cycle**
  - Baseline SEMP due at SRR/MDR
  - Updates not required every phase; however updates are recommended as changes to contents occur
  - Consider the SEMP to be a living document that is used to capture agreements

  - Section 2.4: "Technical Plan " used to be "Work Plan for Phase" to reflect change

- **Process Allocation Table (Section 3.1)**
  - Added for clarification of roles and responsibilities across segments/ organizations

Technical Process	*Segment/Element 1 SE*	*Segment/Element 2 SE…*	*Segment/Element N SE*
Understanding the Objectives	*Functions performed associated with Process*	*Functions performed associated with Process*	*Functions associated with Process*
Mission Environments	*Functions performed associated with Process*	*Functions performed associated with Process*	*Functions performed associated with Process*
…	*Functions performed associated with Process*	*Functions performed associated with Process*	*Functions performed associated with Process*

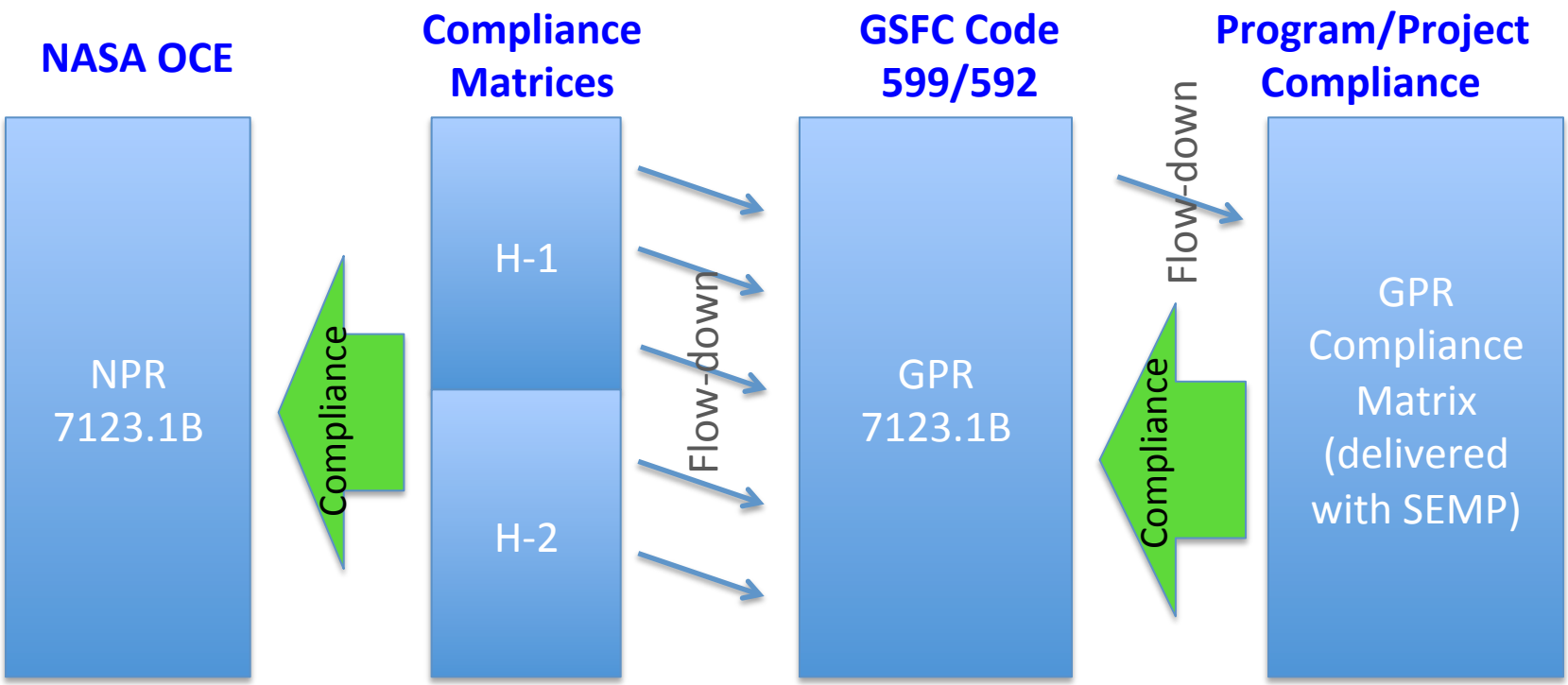
What Changed in SEMP's? (2/3)

- **Section 4.2.4**
  - "List the **technical performance measures** and technical resource budgets Systems Engineering will track"
  - Changed due to expansion of items to be tracked.

- The GPR Compliance matrix is now an attachment provided as an Excel file.

What Changed in SEMP's? (3/3)

- SEMP Compliance Matrix Updated to reflect GPR changes
  - Created an excel attachment as a separate deliverable to the SEMP
  - This is a key deliverable by programs/projects to demonstrate GSFC Compliance to NPR 7123.1



Round Up/Plans for GPR 7123.1

- **Upcoming GDMS Release ASAP – Review/Comments are WELCOME!!!**
  - ”Redlines only”
  - Feel free to submit additional Change Requests (CR’s) for next revision
- **The Goals for this GPR 7123.1 update:**
  - Ensure continued compliance with NPR 7123.1 as a result of the changes.
  - Consolidate requirements to reduce the overall requirement count
- **A revision is planned during Summer 2014:**
  - To address and tailor requirements for Class D projects
  - Roll in residual change requests accumulated during this update cycle not related to the goals above
  - This will include major updates to Appendix E and F of the GPR

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Questions?