

# NOAA/NESDIS



**NESDIS-PR-1302.1**

## **REQUIREMENTS MANAGEMENT PROCEDURAL REQUIREMENTS**

**March 01, 2019**

**COMPLIANCE IS MANDATORY**



**Prepared by:**

**U.S. Department of Commerce**

**National Oceanic and Atmospheric Administration (NOAA)**

**National Environmental Satellite, Data, and Information Service (NESDIS)**



**NESDIS  
Procedural  
Requirements**

**NESDIS-PR-1302.1**  
Effective Date: March 01, 2019  
Expiration Date: February 29, 2024

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## Approval Page

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|--|---|
| Document Number: <b>NESDIS-PR-1302.1</b>   |   |
| Document Title Block:<br><b>NESDIS REQUIREMENTS MANAGEMENT PROCEDURAL REQUIREMENTS</b> |   |
| <b>Process Owner:</b><br>Frank Gallagher   | <b>Document Release Date:</b><br>March 01, 2019 |

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May 14, 2019  
Date:



## Document Change Record

| VERSION | Description                                  | CCR # | Revised Sections | Date         |
|---------|--|-------|------------------|--------------|
| 0.1     | Initial version                              |       | All              | Jan 1, 2018  |
| 0.2     | Address SEWG comments                        |       | All              | May 21, 2018 |
| 0.3     | Address additional SEWG comments             |       | All              | Oct 15, 2018 |
| 1.0     | Address additional comments from AIMS review |       | All              | Feb 14, 2019 |
|         |  |       |                  |              |
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## **PREFACE**

### **P.1 PURPOSE**

The purpose of this Procedural Requirements (PR) document is to establish the process and criteria by which the National Environmental, Satellite, Data and Information Service (NESDIS) will develop and manage its requirements. Requirements management is a process used to gather, analyze, decompose, validate, track, and manage changes to requirements used in the development of NESDIS products. It applies to all NESDIS projects regardless of scope and size.

### **P.2 APPLICABILITY**

- a. This PR applies to all NESDIS Offices (as defined in Appendix A). It applies to NESDIS employees and NESDIS support contractors that provide NESDIS technical work. It applies to other contractors, grant recipients, or parties to agreements only to the extent specified or referenced in the appropriate contracts, grants, or agreements.
- b. NESDIS Offices may develop office-level requirements management processes (if needed) that conform to this PR.
- c. The requirements enumerated in this document are applicable to all projects (as defined in Appendix A). For existing projects, the Director of the Office of System Architecture and Advanced Planning (OSAAP) may approve requests for variance allowing continuation of current practices.
- d. NOAA collaborates with many domestic and international partners to fulfill its mission. With OSAAP's concurrence and mutual agreement, NESDIS Offices may tailor the requirements of this PR or follow the partner's requirements management approach. This document should be used as a reference to compare with the partner's processes to verify their completeness.
- e. In this PR, all mandatory actions (i.e. requirements) are identified by the symbol "[REQ]" to unambiguously define all requirements. They are also captured in the Requirements Matrix in Appendix C. The Requirements Matrix takes precedence if there are any discrepancies between the narrative and the matrix with respect to identifying requirements. The terms "shall" and "must" are not used to specify mandatory actions because they can be interpreted as legally-binding terminology, which removes all agency discretion and can create a potential liability problem for NOAA/NESDIS.

### **P.3 AUTHORITY**

NESDIS-PD-1110.1, NESDIS Systems Engineering and Program Management Policy.

### **P.4 APPLICABLE DOCUMENTS**

- NESDIS-PR-1300.1, NESDIS Systems Engineering Procedural Requirements.



## Chapter 1. Introduction

- a. Requirements management applies to the management of all requirements starting from the stakeholder requirements and extending down to the lowest level. This includes:
  - Stakeholder requirements,
  - Requirements derived from stakeholder requirements including functional, performance, interface, environmental, safety, human interfaces, standards requirements,
  - Requirements to specify “ilities” such as reliability, sustainability, availability, and
  - Other programmatic (sometimes called non-technical) requirements.
- b. The Requirements Management Process is used to:
  - Gather, analyze, allocate, decompose, and validate requirements
  - Provide bidirectional traceability
  - Manage the changes to established requirement baselines
  - Report requirements metrics and status
- c. The requirements established in this PR may be tailored using the guidelines provided in Chapter 3.
- d. Figures within this PR are intended to be notional, not prescriptive.
- e. Hierarchy of Related Documents: This PR focuses on requirements management procedural requirements. It flows down from NESDIS-PR-1300.1, NESDIS Systems Engineering Procedural Requirements, as shown in Figure 1.

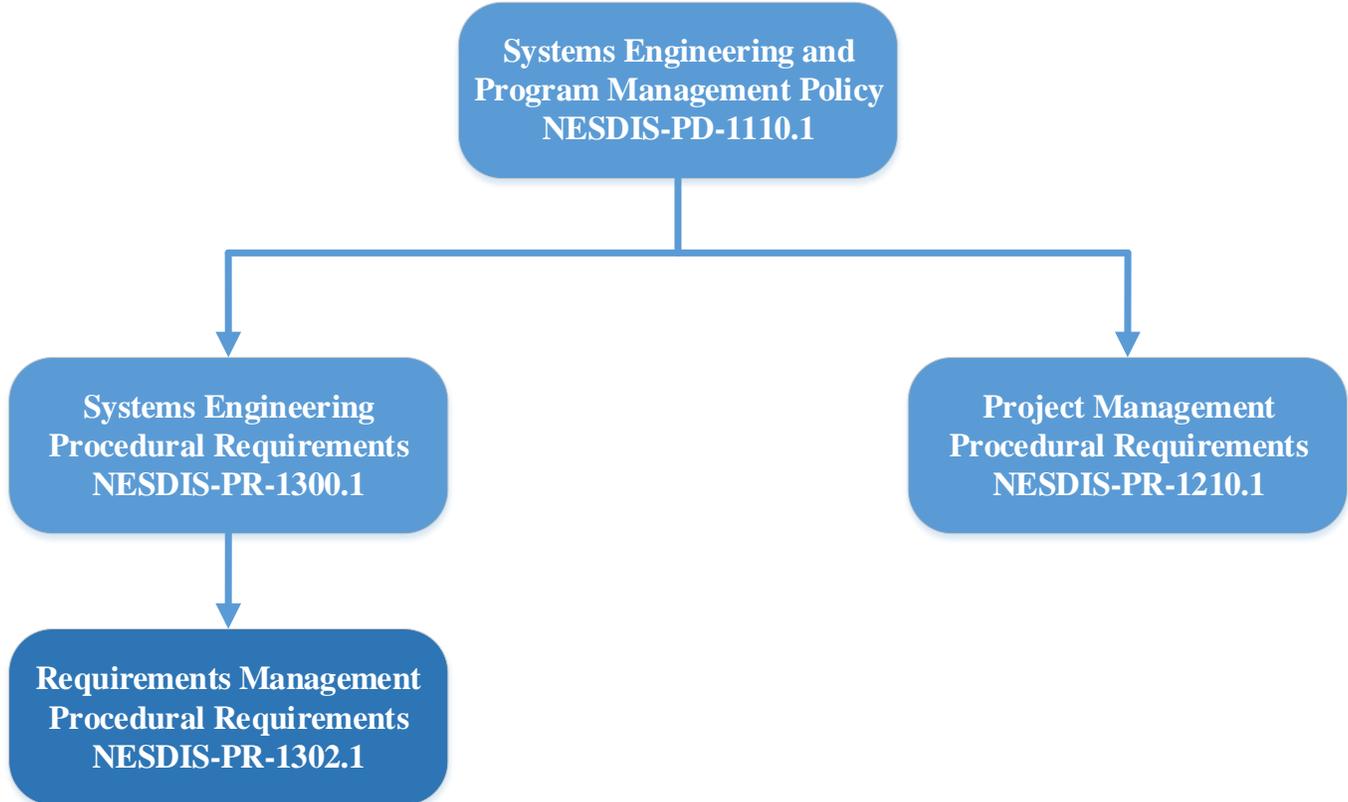


Figure 1. Hierarchy of Related Documents



## **Chapter 2. Roles and Responsibilities**

### **2.1 Office of System Architecture and Advanced Planning**

[REQ-001] OSAAP ensures compliance with this PR.

OSAAP will review and approve the Requirements Management Plans (RqMPs) for all projects that do not execute solely within a single NESDIS Office, or meet the following criteria per DOC Policy:

- Does the project require special management attention because of its importance to NESDIS' mission or functions?
- Does the project have significant policy implications?
- Does the project have external visibility?
- Does the project have high development, operating, or maintenance costs?
- Does the project have unusual funding mechanism?
- Is the project defined as major by DOC capital planning and investment control process?

### **2.2 NESDIS Office Directors**

[REQ-002] NESDIS Office Directors establish policies, processes, and procedures within their offices to execute the requirements of this PR.

[REQ-003] Deleted.

### **2.3 Program/Project Manager**

[REQ-004] The Project Manager allocates adequate resources to meet the requirements of this PR commensurate with the scope, size, and complexity of the project.



## Chapter 3. Requirements Management Procedural Requirements

### 3.1 Requirements Definitions

- a. A requirement is a statement that identifies a system, product, service, or process characteristic or constraint.
- b. Characteristics of good requirements: Good requirements are those that are necessary, implementation independent, clear and concise, complete, consistent, achievable, traceable, and verifiable.
- c. Collectively, the requirements are not redundant, are adequately related with respect to terms used, and are not in conflict with one another.
- d. Table 1 provides the definitions for NESDIS Levels of Requirements.

**Table 1. NESDIS Requirement Levels**

| Level | Definition   |
|-------|--|
| 0     | Define customer expectations in the context of the NESDIS mission, strategic plans, Mission Essential Functions (MEFs), policies and regulations.  |
| 1     | Define expectations for the particular program, service, or system of interest, in the context of programmatic boundaries and constraints. Include system functional and technical performance goals and objectives to guide, bound, and focus the system design for its intended purpose. |
| 2     | Define the detailed system functional and performance requirements in the context of the implementing organization, taking into consideration institutional constraints, assumptions, and environmental and other design constraints and guidelines.                                       |
| 3     | Define subsystem functional and performance requirements consistent with the decomposition of the system into manageable and necessary pieces, and in the context of the organization to which the subsystem is entrusted.   |
| 4     | Define further decomposition for each of the subsystems into components for further allocation and derivation of requirements.   |
| 5     | Define further decomposition for each of the components into lower level parts.  |

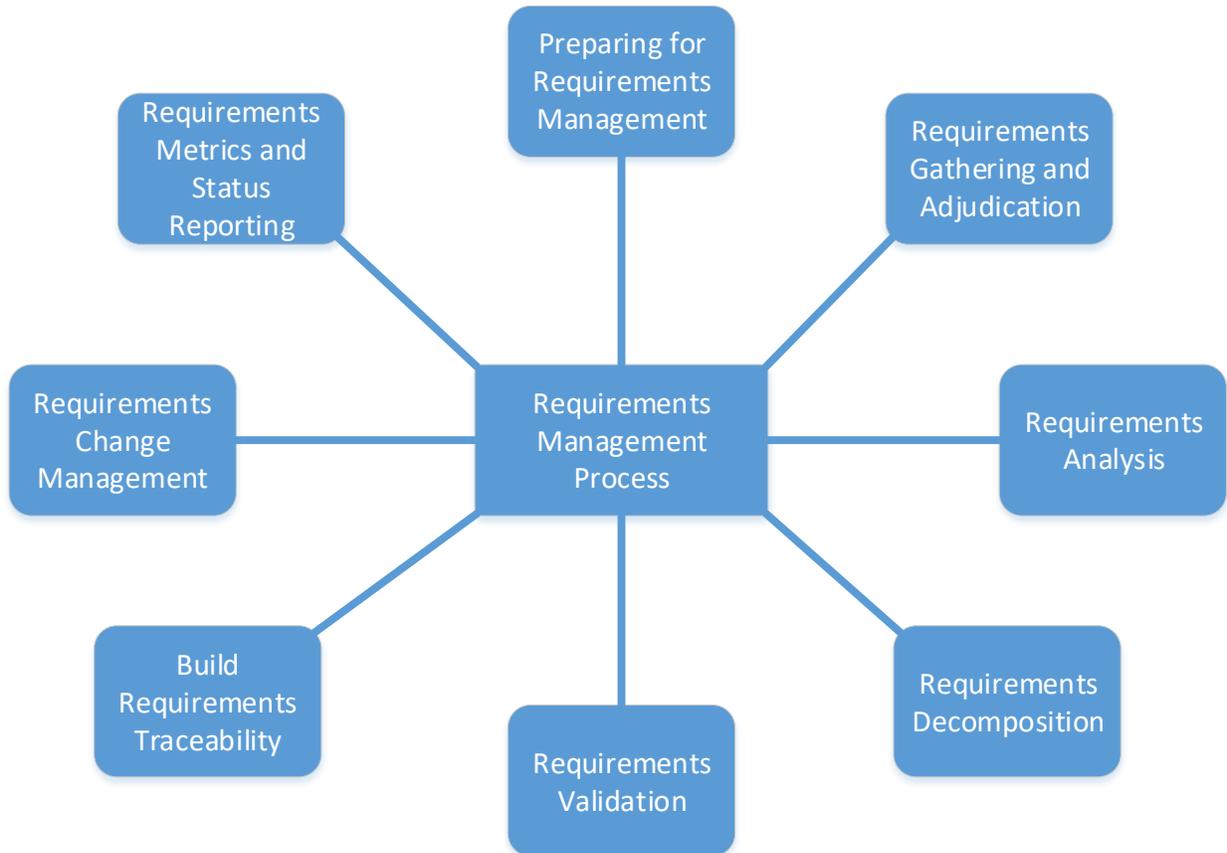
- From a NESDIS perspective, a Level 0 requirement answers the question ‘What does NESDIS do?’ These are performance and functional requirements, as well as interfaces with NESDIS users.
- From these Level 0 requirements are derived Level 1 requirements that flow to NESDIS Offices, and/or projects that define what is expected of them to support NESDIS in meeting its Level 0 requirements. Level 1 requirements also define the interfaces between Offices and projects.
- The Level 2 requirements flow to specific implementations within these NESDIS Offices or projects to support their respective Level 1 requirements.

**Note:** This Requirements Level definition is from a NESDIS perspective. To avoid confusion, it is entirely acceptable to renumber lower-level requirements as the need arises. For instance, NESDIS Level 5 requirements can be considered a subcontractor’s Level 1 requirements. If renumbering is done, it must be mapped back to the NESDIS-level numbering in the requirements flow trace.

## 3.2 Requirements Management Process

### 3.2.1 Process Description

Figure 2 shows the main activities of the requirements management process.



**Figure 2: Requirements Management Process**

1. Preparing to conduct requirements management: This activity is used to:
  - Define the requirements management approach and process flow,
  - Establish the organizational elements (ex: requirement management boards, integrated project teams, etc.), and procedures used to perform requirements management,
  - Select appropriate requirements management tools,
  - Provide training to requirements management personnel, and
  - Write the Requirements Management Plan, which guides and governs all stakeholders throughout the requirements management life cycle.
2. Requirements gathering and adjudication: The purpose of this activity is to:
  - Identify and document Level N requirements, including constraints and priorities,
  - Define measures of effectiveness for the Level N requirements,
  - Review, validate, and adjudicate the Level N requirements and the measures of effectiveness with Level N stakeholders,
  - Obtain approval from Level N stakeholders as well as from Level N implementing NESDIS Office management,
  - If not yet baselined, baseline the approved Level N requirements, and



- If not yet established, establish a requirements traceability matrix.

Note: If there are Level N-1 requirements already in place, it is important to ensure that these requirements are baselined and approved prior to this activity.

3. Requirements analysis: The purpose of this activity is to:

- Evaluate the baselined Level N requirements for consistency with the current Concept of Operations (ConOps) and architecture,
- Ensure that each requirement meets the “Characteristics of good requirements” (3.1.b) criteria, and
- Approve development of the Level N+1 requirements

Note: If new Level N requirements are identified, the previous activities are repeated to ensure that this activity can be successfully completed.

4. Requirements decomposition: The purpose of this activity is to:

- Decompose each Level N requirement into one or more Level N+1 requirements,
- Update the requirements traceability matrix, and
- At an appropriate level, document the requirements in the System Requirements Specification (SRS).

Note: Level N+1 requirements are written in a manner that Level N stakeholders can understand the requirements. For example, Level 2 requirements must be understandable for Level 1 stakeholders.

5. Requirements validation: The purpose of this activity is to:

- Prove that the requirements are recorded correctly,
- Verify (against a set of criteria), and validate the Level N+1 with Level N stakeholders,
- Provide an opportunity to the Level N stakeholders to ensure that the Level N+1 requirements reflect the system they need and expect,
- Obtain approval to transition to the next stage of system life cycle from 1) Level N stakeholders and 2) NESDIS Offices implementing Level N requirements
- Baseline the approved Level N+1 requirements,
- Update the requirements traceability matrix, and
- Review Level N+2 requirements (when available) for consistency.

Note: If incomplete Level N or Level N+1 requirements are found, the previous activities are repeated to ensure that this activity can be successfully completed.

6. Build Requirements Traceability: The purpose of this activity is to:

- Establish bidirectional traceability for each requirement by tracing each requirement to a parent/source requirement (or identifying the requirement as self-derived),
- Ensure that all top-level requirements have been allocated to lower level requirements,
- Resolve duplication between levels, and
- Establish traceability from requirements to other artifacts such as architectural/design documents, test cases, and other systems engineering and project deliverables.

Note: Requirements traceability is a continuous process throughout the project life cycle.

7. Requirements change management: The purpose of this activity is to:

- Provide an approach to manage changes to the requirements baseline,
- Receive, analyze and evaluate the proposed change to requirements,
- Receive, analyze, and evaluate waiver requests,
- Complete an impact analysis of the proposed change to maintain consistency between the ConOps, architecture, and requirements,



- Accept, reject, or defer the change request,
- Update the requirements documents and the traceability matrix,
- Communicate the decision to all stakeholders, and
- Ensure that the approved changes are incorporated into the baselines.

Note: This requires coordination with the configuration management processes established by the implementing NESDIS Office.

8. Requirements metrics and status reporting: The purpose of this activity is to:

- Establish and track requirements metrics, and
- Report the status of requirements periodically or on-demand.

Some examples of requirements metrics are: number of use-cases; number of requirements; number of requirements added, modified, or deleted; number of test cases; number of requirements traced to use cases; number of requirements traced to test cases; number of requirements traced to (or not traced to) parent/child requirements.

### **3.2.2 Requirement Management Process Requirements**

[REQ-005] All NESDIS requirements management activities will use the requirements levels defined in Table 1.

[REQ-006] NESDIS Offices and projects will establish their own Requirements Management Boards (RqMBs) to manage their respective requirements. NESDIS Offices may use a single RqMB to manage requirements for multiple projects.

[REQ-007] The RqMB will establish a Requirements Management Plan to provide specific guidance on how the requirements management process is executed.

[REQ-008] The RqMB will receive requirements, analyze and organize them in a hierarchical tree structure.

[REQ-009] The RqMB will establish bidirectional traceability between requirements.

[REQ-010] The RqMB will ensure that requirements are validated against the stakeholder expectations, the mission objectives and constraints, the operational objectives, and the mission success criteria.

[REQ-011] The RqMB will define a verification method for each requirement.

[REQ-012] The RqMB will trace each requirement to a suitable verification event.

[REQ-013] The RqMB will perform and maintain configuration control of the requirements.

[REQ-014] The RqMB will evaluate change requests to the requirements baseline over the life of the project and make changes if approved.

[REQ-015] Working with other organizational elements responsible for the architecture and the ConOps, the RqMB will maintain consistency between the requirements, the ConOps, and the architecture/design.

[REQ-016] The RqMB will establish requirements metrics and status reporting guidelines.

[REQ-017] The RqMB will report requirements metrics and status periodically and on demand.

### **3.2.3 Requirements Waivers**

At any level, a child (Level N+1) requirement that impacts meeting a Level N requirement may be identified for a waiver request. The waiver request will follow the requirements change management



process defined in the Requirements Management Plan (RqMP, see Section 3.3).

[REQ-32] If a requirement is identified for a waiver request, the requirements change management process defined in the RqMP is used to request and obtain a requirements waiver.

### **3.3 Requirements Management Plan (RqMP)**

A RqMP is used to provide specific guidance to a project on how the requirements management process is executed to manage the requirements of a project.

#### **3.3.1 Requirements Management Plan Requirements**

[REQ-018] Determine the appropriate level at which the RqMP is to be developed, taking into account the factors such as number and complexity of interfaces, operating environments, and risk factors.

[REQ-019] Ensure that the RqMP is consistent with higher-level requirements management plans.

[REQ-020] Define how the requirements management process, including tailoring, will be applied during each applicable life-cycle phase.

[REQ-021] Identify the relevant stakeholders.

[REQ-022] Describe how requirements management, requirements traceability, change control, and status reporting will be accomplished.

[REQ-023] Describe the assigned resources, roles and responsibilities to perform requirements management activities.

[REQ-024] Provide a schedule for performing the requirements management activities.

[REQ-025] Define the level of configuration management control for all requirements management work products.

[REQ-026] Baseline the Requirements Management Plan for the System Requirements Review (SRR) or equivalent milestone.

[REQ-027] Identify the training for those who will be performing the requirements management activities.

[REQ-028] Update, review, and reapprove the Requirements Management Plan in accordance with the project schedule for requirements management activities or when significant changes occur.

### **3.4 Tailoring Guidelines**

- a. Tailoring is the process used to seek relief from the requirements of this PR consistent with project objectives, allowable risk, and constraints.
- b. The tailoring process should occur at the beginning of a project, but may occur at any time in the project's life cycle. It results in changes to the implementation of requirements depending on the timing of the request.
- c. A tailoring request is submitted to OSAAP by identifying the requirements that need to be tailored in the compliance matrix provided in Appendix C, along with justification for the tailoring request.
- d. OSAAP will have responsibility to approve or disapprove any tailoring request for this document.

#### **3.4.1 Tailoring Requirements**

[REQ-029] Requests for tailoring are submitted through the change management process.



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Effective Date: March 01, 2019  
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**[REQ-030]** The results of tailoring are documented in the Requirements Matrix (Appendix C) and submitted to OSAAP for approval along with supporting rationale.

**[REQ-031]** The results of the tailoring will be documented in the next revision of the Requirements Management Plan.



## Appendix A: Glossary

**Baseline:** An agreed-to set of requirements, designs, or documents that will have changes controlled through a formal approval and monitoring process.

**Concept of Operations (ConOps):** Describes the overall high-level concept of how the system will be used to meet stakeholder expectations, usually in a time sequenced manner. It describes the system from an operational perspective and helps facilitate an understanding of the system goals. It stimulates the development of the requirements and architecture related to the user elements of the system. It serves as the basis for subsequent definition documents and provides the foundation for the long-range operational planning activities.

**NESDIS Office(s):** A term used in the widest sense to include NESDIS Headquarters elements, NESDIS Operations and Acquisitions offices, the Center for Satellite Applications and Research (STAR), and the National Centers for Environmental Information (NCEI).

**Process:** A set of activities used to convert inputs into desired outputs to generate expected outcomes and satisfy a purpose.

**Product:**

- (1) A part of a system that performs operational functions or life-cycle services.
- (2) Result of the technical efforts (e.g., plan, baseline, or test result).
- (3) Derived data from the raw instrument measurements in a specific output format. Products may be classified as Level 0, Level 1, and Level 2+ depending on their degree of processing.

**Program:** A strategic investment by an office that has defined goals, objectives, architecture, funding level, and a management structure that supports one or more projects.

**Project:** A specific investment having defined goals, objectives, requirements, life-cycle cost, a beginning, and an end. A project yields new or revised products or services that directly address NESDIS' strategic needs. They may be performed wholly in-house; by Government, industry, or academia partnerships; or through contracts with private industry. In this document, readers should treat the term 'project' in the widest sense, to include projects, programs, portfolios, and major initiatives.

**Requirement:**

- (1) A statement that identifies a system, product, or process characteristic or constraint.
- (2) The agreed upon need, desire, want, capability, capacity, or demand for personnel, equipment, facilities, or other resources or services by specified quantities for specific periods of time or at a specified time.

**Requirements management:** A process used to gather, analyze, decompose, validate, track, and manage changes to requirements.

**Risk:** In the context of mission execution, the potential for performance shortfalls, which may be realized in the future, with respect to achieving explicitly established and stated performance requirements. The performance shortfalls may be related to any one or more of the following mission execution domains: (1) safety, (2) technical, (3) cost, and (4) schedule.

**Stakeholder:** A group or individual who is affected by or has an interest in a project.

**System:** The combination of elements that function together to produce the capability required to meet a need. The elements include all hardware, software, equipment, facilities, personnel, processes, and procedures needed for this purpose.



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**Tailoring:** The process used to seek relief from the PR requirements consistent with program or project objectives, allowable risk, and constraints.

**Traceability:**

- (1) The degree to which a relationship can be established between two or more products of the development process.
- (2) Discernible association among two or more requirements, system elements, verifications or tasks.

**Validation (of a product):** The process of showing proof that the product accomplishes the intended purpose based on stakeholder expectations and the Concept of Operations. May be determined by a combination of test, analysis, demonstration, and inspection. (Answers the question, “Am I building the right product?”)

**Validation (of Requirements):** The continuous process of ensuring that requirements are well-formed (clear and unambiguous), complete (agrees with customer and stakeholder needs and expectations), consistent (conflict free), and individually verifiable and traceable to a higher level requirement or goal. (Answers the question, "Will I build the right product?")

**Variance:** A departure from approved product definition information, for a limited amount of time or for a specified effectivity, that does not require revision of approved product definition information.

**Verification (of a product):** Proof of compliance with requirements/specifications. Verification may be determined by test, analysis, demonstration, inspection, or a combination thereof. (Answers the question, “Did I build the product right?”)

**Verification (of requirements):** The process of confirmation, through objective evidence, that specified requirements have been fulfilled.

**Waiver:** A documented authorization releasing a program or project from meeting a requirement after the requirement is put under configuration control at the level the requirement will be implemented.



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## Appendix B: Acronyms

|        |   |
|--------|---|
| ConOps | Concept of Operations   |
| INCOSE | International Council on Systems Engineering                    |
| NASA   | National Aeronautics and Space Administration                   |
| NCEI   | National Centers for Environmental Information                  |
| NESDIS | National Environmental Satellite, Data, and Information Service |
| NOAA   | National Oceanic and Atmospheric Administration                 |
| OSAAP  | Office of System Architecture and Advanced Planning             |
| PR     | Procedural Requirements   |
| REQ    | Requirements  |
| RqMB   | Requirements Management Board                                   |
| RqMP   | Requirements Management Plan                                    |
| SRS    | System requirements Specification                               |
| STAR   | Satellite Applications and Research                             |



### Appendix C: Requirements Matrix

| Section | REQ# | Requirement  |
|---------|------|--|
| 2.1     | 001  | OSAAP ensures compliance with this PR.   |
| 2.2     | 002  | NESDIS Office Directors establish policies, processes, and procedures within their Office to execute the requirements of this PR.  |
| 2.2     | 003  | Deleted.   |
| 2.3     | 004  | The Project Manager allocates adequate resources to meet the requirements of this PR commensurate with the scope, size, and complexity of the project.   |
| 3.2     | 005  | All NESDIS requirements management activities will use the requirements levels defined in Table 1.   |
| 3.2     | 006  | NESDIS Offices, portfolios, programs, and projects will establish their own Requirements Management Board (RqMB) to manage their respective requirements. NESDIS Offices may use a single RqMB to manage requirements for multiple projects.     |
| 3.2     | 007  | The RqMB will establish a Requirements Management Plan to provide specific guidance on how the requirements management process is executed.  |
| 3.2     | 008  | The RqMB will receive requirements, analyze and organize them in a hierarchical tree structure.  |
| 3.2     | 009  | The RqMB will establish bidirectional traceability between requirements.   |
| 3.2     | 010  | The RqMB will validate requirements against the stakeholder expectations, the mission objectives and constraints, the operational objectives, and the mission success criteria.  |
| 3.2     | 011  | The RqMB will define a verification method for each requirement.   |
| 3.2     | 012  | The RqMB will trace each requirement to a suitable verification event.   |
| 3.2     | 013  | The RqMB will perform and maintain configuration control of their requirements.  |
| 3.2     | 014  | The RqMB will evaluate change requests to the requirements baseline over the life of the project and make changes if approved.   |
| 3.2     | 015  | The RqMB will maintain consistency between the requirements, the ConOps, and the architecture/design.  |
| 3.2     | 016  | The RqMB will establish requirements metrics and status reporting guidelines.  |
| 3.2     | 017  | The RqMB will report requirements metrics and status to internal and/or external stakeholders.   |
| 3.2     | 032  | If a requirement is identified for a waiver request, the requirements change management process defined in the RqMP is used to request and obtain a requirements waiver.   |
| 3.3     | 018  | Determine the appropriate level within the system structure at which the Requirements Management Plan is to be developed, taking into account the factors such as number and complexity of interfaces, operating environments, and risk factors. |
| 3.3     | 019  | Ensure that the Requirements Management Plan is consistent with higher-level requirements management plans.  |
| 3.3     | 020  | Define how the requirements management process, including tailoring, will be applied during each applicable life-cycle phase.  |
| 3.3     | 021  | Identify the relevant stakeholders.  |
| 3.3     | 022  | Identify the tools that will be used for requirements management, build requirements traceability, change control, and status reporting.   |



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| 3.3 | 023 | Describe the assigned resources, roles and responsibilities to perform requirements management activities.   |
| 3.3 | 024 | Provide a schedule for performing the requirements management activities.  |
| 3.3 | 025 | Define the level of configuration management control for all requirements management work products.  |
| 3.3 | 026 | Baseline the Requirements Management Plan for the System Requirements Review (SRR) or equivalent milestone.  |
| 3.3 | 027 | Identify the training for those who will be performing the requirements management activities.   |
| 3.3 | 028 | Update, review, and reapprove the Requirements Management Plan in accordance with the project schedule for requirements management activities or when significant changes occur. |
| 3.4 | 029 | Requests for tailoring are submitted through the configuration management process.   |
| 3.4 | 030 | The results of tailoring are documented in the Requirements Matrix (Appendix C) and submitted to OSAAP for approval along with supporting rationale.                             |
| 3.4 | 031 | The results of the tailoring will be documented in the next revision of the Requirements Management Plan.  |



## **Appendix D: References**

1. NASA Systems Engineering Handbook, Rev 1, NASA/SP-2016-6105 REV 2, February 2017.
2. INCOSE Systems Engineering Handbook, INCOSE-TP-2003-002-04 2015.



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