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| **Small Spacecraft Technology Program****Configuration Management Plan Instructional Guide** |
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DOCUMENT HISTORY LOG

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This document is a template to be used for projects when they need to create a CMP document. All the text and figures following are an EXAMPLE ONLY and must be modified for the specific mission, launch vehicle or integrator. Some roles being specified may not be applicable to your organization and should be tailored as such. Shall and should (Shall: requirement, Should: Goal) statements are used in this example, however, requirements and goals should be tailored to your project (technical scope, resources, risk posture, etc.). Projects shall tailor the content of this document to the relevant risk posture / needs for the project / organization. Remove this paragraph after document has been approved.

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# Purpose

 This Small Spacecraft Technology Program (SSTP) for Configuration Management Plan (CMP) instructional guide is for the spacecraft developer outside of NASA and is intended to provide guidance and thought process when designing small satellites for space. This CMP guide establishes and describes Configuration Management (CM) policies and requirements that may be used by any project.

## 1.1 Scope

The CMP defines the objectives, applicability, and responsibilities for establishing and maintaining project-defined CM requirements. This CMP Instructional Guide provides details to assist in external parties development of their project CMPs. Text in curly brackets “{text}” represent information to be captured (e.g., {Project Name}) when preparing the project-specific CMP, and italic text in curly brackets “*{text}”* represents guidance/information for a section being prepared and should be deleted from the CMP prior to release. An example of the content to be captured is provided throughout the template. Where applicable, reuse/reference of material to relevant project-specific documents (e.g., Project Management Plan, etc) is encouraged; refer to the SSTP Guidebook for Technology Development Projects for an outline of expected project documents to be completed when designing small satellites for space. Appendix A captures a template designed to provide a standard outline and format for CMPs.

## 1.2 Acronyms and Definitions

### 1.2.1 Acronyms

*{examples, add more as applicable}*

CCB Change Control Board

CDR Critical Design Review

CI Configuration Item (Hardware, Software, and/or Documentation, under CM Control)

CM Configuration Management

CMR Configuration Management Representative(s)

CR Change Request

ECO Engineering Change Order

EDC Engineering Document Center

EST Engineering Support Team

ICD Interface Control Document

ISS International Space Station

LSE Lead System Engineer

NCR Non-Conformance Report

TBD To Be Determined

WBS Work Breakdown Structure

### 1.2.2 Definitions

*{instructional only}*

**ITEM DEFINITION**

Baseline: A configuration identification document or a set of such documents formally designated and fixed at a specific time during a configuration item life cycle.

Change Control: The systematic evaluation, coordination, approval or disapproval, and implementation of all approved changes.

Configuration: The functional and/or physical characteristics of hardware or software as set forth in the technical documentation and achieved in the product.

Deviation: A deviation is a specific authorization granted before the creation of an item allowing departure from a particular performance or design requirement of a specification, drawing, or other document for a specific number of units or time. A deviation may not require revision of the applicable document. An approved change is required for revision of the documentation that defines the affected item.

Drawing: A drawing is an engineering document that discloses (directly or by reference) by means of pictorial or textual presentations, or combinations of both, the physical and functional end-product specifications of an item.

End Item: An item or combination of items, which form a product that accomplishes a specific task or function. May include hardware, software and/or documentation.

Fast-Track Changes: Relative low-risk changes which proceed through the change process very quickly and which require the fewest number of approvals.

Hardware: Any physical item which may include individual pieces, components, subassemblies, equipment and subsystems.

Interface: A common boundary between two or more items. This boundary may be electrical, mechanical, functional, or contractual.

Part: A piece part, subassembly, assembly, component, or subsystem. Piece parts include resistors, capacitors, transistors, relays, screws, gears, etc.

Program: An activity within an Enterprise having defined goals, objectives, requirements, funding, and consisting of one or more projects.

Project: An activity designated by a program and characterized as having defined goals, objectives, requirements, life cycle costs, a beginning, milestones and an end.

Release: The process of officially identifying documentation as authorized for use by manufacturing, procurement, and other users.

Software: A set or combination of electronic instructions and data definitions.

Specification: A document which clearly and accurately describes the essential technical requirements for items, materials or services including the procedures by which it will be determined that the requirements have been met.

System: A grouping of subsystems, assemblies, skills and techniques capable of performing and supporting an operational or non-operational role. A complete system includes related facilities, items, services, and personnel required for its operation as a self-sufficient entity.

Verification: The process of evaluating the products of a given phase of the product life cycle to ensure correctness and consistency with respect to the product’s baseline specifications.

Waiver: A waiver is a written, one-time authorization to accept an item, which during the production or after having been submitted for inspection, is found to depart from specified requirements, but nevertheless are considered suitable for use “as is” or after rework by an approved method.

# Configuration Management

*{High level overview of different responsibilities of various project positions; define further if necessary, example as follows}*



Figure 1. CMP Roles and Responsibilities Organizational Chart

## Organization and Responsibilities *{relationship of CM to life cycle of project}*

### 2.1.1 Program Office *{group that defines the CM requirements in a Program Plan}*

The Program Office defines the CM requirements in the form of Program Plans, which may be further customized to the project(s) of interest. The Program Office Program Manager has the responsibility and authority to implement and control CM activities.

### 2.1.2 Project Office *{outlines how the CM requirements shall be met}*

The Project Plan, written by the Project Manager, shall outline how the CM requirements in the Program Plan shall be met. Project Managers may elect to incorporate CMP content within the Project Plan or the Software Management Plan or reference the CMP.

### 2.1.3 Configuration Management Representative(s) (CMR) *{group responsible for managing the CM activities}*

The CMR reports directly to the Program/Project Manager *{define; dependent on the organization or project}*. The CMR is responsible for managing the Program/Project CM activities in accordance with the CMP and shall (as agreed between the Program/Project Manager and Lead System Engineer (LSE):

* Provide CM guidance, direction and support.
* Facilitate and endorse the documentation, implementation, and maintenance of the CM processes.
* Coordinate with Program/Project team members, change control boards, and other individuals involved in managing, operating, and maintaining the CM process.
* Ensure that updates to the configuration information, CM library information and change requests are maintained in a CM Status Accounting System.
* Updates and posts all documents into the database as well as archives all documents at the end of the project.
* Verifies that no outdated items or drawings are in use following acceptance of changes (i.e., works with test and manufacturing leads).
* Perform periodic configuration audits, at the discretion of the Program/Project Manager, to verify that only current versions of configuration items are in use.

### 2.1.4 Change Control Board (CCB) *{review board consisting of technical and administrative personnel}*

The CCB shall consist of technical and administrative personnel who meet on an as-required basis to (as defined by the Program/Project Manager and CMR):

* Authorize release of drawings, documents, hardware and/or software for the program/project baseline.
* Review and disposition proposed changes to program/project baseline drawings, documents, hardware and/or software.
* Establish criteria for what shall be processed as fast-track changes.
* The CCB will participate in the review and disposition of Change Requests (CR), Non-Conformance Reports (NCRs), and Engineering Change Orders (ECOs).
* The CCB includes but is not limited to:
	+ Program/Project Manager (e.g., Chairperson)
	+ Project Engineer
	+ CMR
	+ Group leads and technical consultants as required
	+ Others as designated by the Chairperson
* The Program/Project Manager will have final disposition authority on all CCB issues.

### 2.1.5 Other Support *{as defined by the Project Office}*

The Project Office may request specific reviews by the Engineering office, Quality Assurance and/or Safety, in support relative to a specific change request and/or other support action.

# Configuration Management Activities

*{Overview regarding the identification system and numbering protocol for data; define further if necessary, example as follows}*

## 3.1 Hardware Identification *{labeling and numbering scheme}*

Items to be produced in support of the project deliverables shall be evaluated for control requirements. All items determined to be a Configuration Item (CI) shall be assigned a unique part number that is identical to that assigned to a fabrication or assembly drawing.

### 3.1.1 Criteria for Using Dash Numbers

* When using a group or a family of parts. Example: a gasket set MXXX-1, MXXX-2, MXXX-3. This could also be used for some assemblies.
* When using a part that has multiple configurations in use. Example: a PCB that has one schematic layout but is used for different applications.
* When having the same item manufactured by more than one manufacturer. Example: Part # MXXX-1 from Company A and MXXX-2 from Company B.

## 3.2 Document Identification *{labeling and numbering scheme}*

Technical and other supporting documents shall carry a unique document number for internal data management. A project number is requested by the CMR and is issued by the Engineering Support Team (EST). The CMR will create and issue specific drawing and document numbers from the number provided by the EST and attach the appropriate alpha characters as outlined in Sections 3.2.1 and 3.2.2.

### 3.2.1 Configuration Structure

 To identify the project documents, the following convention is defined for all documents:

TZPZ-XX-Y\_ \_ \_ (Example: TZPZ-05-E001)

ZPZ The number of satellite and payload

XX The Work Breakdown Structure (WBS) specific to the document. See Appendices B and C for convention

Y Configuration Structure. See Appendix D for convention

The following numbering protocol shall be used for identifying the project documents for {Project Name}: *{Projects may change as necessary}*

 TZPZ-XX-E\_ \_ \_ Electrical (Schematics and Wiring Diagrams)

TZPZ-XX-M\_ \_ \_ Mechanical (Assembly, Fabrication Drawings and Part Numbers)

TZPZ-XX-PD\_ \_ \_ PCB Draft Dimension Drawings

TZPZ-XX-PC\_ \_ \_ PCB Layout (Gerber File)

TZPZ-XX-PL\_ \_ \_ Parts List

TZPZ-XX-XA\_ \_ \_ Agreements, Architectural and Engineering studies, Reviews such as CDR and Operational Readiness Review. (i.e. PRR, PDR, CDR, etc.)

TZPZ-XX-XB\_ \_ \_ Management / Financial Plans, Reports and Studies. (Project Management Plans, Schedules, cost estimates)

TZPZ-XX-XC\_ \_ \_ Computer Software Listings and Codes

TZPZ-XX-MA\_ \_ \_ Manuals and Instructions, Work Instructions – Procedures

TZPZ-XX-XR\_ \_ \_ Requirements Documents, (ICD), Specifications, Engineering Design

TZPZ-XX-XS\_ \_ \_ Safety/Hazard Plans Reports, Studies and Analyses

TZPZ-XX-XT\_ \_ \_ Test Documentation (Plans, Acceptance, Verification / Validation, Results and Reports)

TZPZ-XX-XV\_ \_ \_ Process Forms, Travelers, Verification / QA Docs (etc.)

The following numbering protocol shall be used for Internal Documentation only for {Project Name}:

TZE-XX-E\_ \_ \_ Electrical (Schematics and Wiring Diagrams)

TZE-XX-M\_ \_ \_ Mechanical (Assembly, Fabrication Drawings and Part Numbers)

TZE-XX-PD\_ \_ \_ PCB Draft Dimension Drawings

TZE-XX-PC\_ \_ \_ PCB Layout (Gerber File)

TZE-XX-PL\_ \_ \_ Parts List

TZE-XX-XA\_ \_ \_ Agreements, Architectural and Engineering studies, Reviews such as CDR and Operational Readiness Review. (i.e. PRR, PDR, CDR, etc.)

TZE-XX-XB\_ \_ \_ Management / Financial Plans, Reports and Studies. (Project Management Plans, Schedules, cost estimates)

TZE-XX-XC\_ \_ \_ Computer Software Listings and Codes

TZE-XX-MA\_ \_ \_ Manuals and Instructions, Work Instructions – Procedures

TZE-XX-XR\_ \_ \_ Requirements Documents, (ICD), Specifications, Engineering Design

TZE-XX-XS\_ \_ \_ Safety/Hazard Plans Reports, Studies and Analyses

TZE-XX-XT\_ \_ \_ Test Documentation (Plans, Acceptance, Verification / Validation, Results and Reports)

TZE-XX-XV\_ \_ \_ Process Forms, Travelers, Verification / QA Docs (etc.)

If an approved document is later canceled, that document number should not be reissued to avoid duplication in the system.

### 3.2.2 Numbering System for Sketches

Sketches being prepared by designers which may or may not lead to controlled engineering drawings should use the following format for identification:

SK-AAA-MM-DD-YY-NN (Example: SK-MBH-04-24-02-100)

 1 2 3 4 5

 SK Represents a project sketch

AAA This will be the initial of the person creating the sketch (first, middle, last). If the person does not have a middle name just use two letters (first and last).

MM The month the sketch was created (2 digits) (e.g., 01, 11)

DD The day of the month (2 digits) (e.g., 01, 24)

YY The year of the sketch (2 digits) (e.g., 02, 12)

NN This will either be a sequential number (1-99) for a given date of it will be the last three numbers of a fabrication drawing that is being modified. (Example: -122 for fabrication assembly TZPZ-XX-M122) (Multi-sheet sketches with the same NN may be used, if appropriate, as long as they are properly identified and numbered in the title number block and –NN sheet page 1 of #, etc. Review proper use of multi-sheet drawings before using this feature to be sure it is applied properly.)

## 3.3 Document Control *{approval levels for drawings and/or documents}*

The Design Project Manager shall approve all documents released for the project. Concurrence from the appropriate technical, quality or systems engineering lead shall be provided, as required, to ensure the documentation conforms to project objectives. Refer to Appendix E for guidance.

### 3.3.1 Approval Levels for Drawings:

Breadboard / Prototype documents will require an approval from the Engineer that designed / created the documents, and the Group Lead (as defined for the project).

Proto Flight documents will require a signature from the Engineer that designed / created the documents, drawing Checker, Project Engineer, and the Group Lead.

Flight documents will require a signature from the Engineer that designed / created the documents, drawing Checker, Project Engineer, and the Group Lead. This may also require the Project Manager and Center QA to sign off.

### 3.3.2 Approval Levels for Documents:

Approval levels on documents will be determined by the Project Manager and the management team (as defined for the project).

### 3.3.3 Document Routing, Circulation and Distribution (CCB)

### 3.3.3.1 Pre-CCB

Documents shall be placed on an Internal Server system in a pre-CCB folder called “Documents for Review”. These documents may be in a preliminary draft form for review and with track-changes/comments enabled.

### 3.3.3.2 CCB Reviewable Items

These are documents that are ready for a final review and approval signature. Once it has been agreed upon that the document is complete it should be routed electronically to those individuals that are specified on the approval page of the document. This routing will either be done by e-mail or through accessing a database system or both. A return response, without changes or comments, shall constitute an official approval signature.

Note: Documents may also be physically routed for signatures depending on the need.

### 3.3.3.3 Signed off Documents

Signed off documents shall be placed into the database system in the Controlled Documents File, in their appropriate (ITAR, CUI, SBU, etc.) secure server on a {name of the server} account.

## 3.4 Project Baseline *{starting point from which subsequent changes are made}*

A design baseline shall be established in accordance with the customer requirements. The design baseline is the set of project and engineering documents, which establishes a starting point from which subsequent changes are made. The project and engineering documentation include, but are not limited to, interface control documents (ICDs), requirements and specifications documents, drawings, test procedures and manufacturing work instructions. These and all other documents will be considered baseline at the time they are approved and placed on {Project Name} server in the Controlled Documents Folder.

## 3.5 Documenting Revisions *{how to capture project documents, hardware, software, drawings, and schematics for subsequent design revisions}*

### 3.5.1 Project Documents

Project Documents (i.e., Project Plans, CMP, ICDs, Science Requirements, etc.) shall be entered into CMR control at revision level of either “–“ or “A”. Subsequent revision levels of a document shall be identified alphabetically in ascending order.

### 3.5.2 Project Hardware and Software

Flight Project Hardware, Drawings and Schematics, and Software should follow the revision process outlined in Table 1.

### 3.5.2.1 Software

A CD is given to CM, for archiving, of each new software release after baseline.

Additional Software CM requirements should be covered in the project Software Management Plan under CM.

Example Table 1

|  |  |  |  |
| --- | --- | --- | --- |
| **Bread Board**Design, Production, Test | **Proto Flight**Design, Production, Test | **Flight**Design, Production, Test | **Delivery** |
| Use the Engineering Document Numbering System (obtain #s from EDC)Release only draft check prints / documents for reviewTrack revisions with Numbers; Start at Rev 1 (i.e. TZPZ-XX-M001 Rev 1) | Use the Engineering Document Numbering System (obtain #s from EDC)Release only draft check prints / documents for reviewTrack revisions with Numbers; Start at Rev 1 (i.e. TZPZ-XX-M001 Rev 1) | Use the Engineering Document Numbering System (obtain #s from EDC)Release non-draft check prints / documents for reviewTrack revisions with Letters; Start at Rev A (i.e. TZPZ-XX-M001 Rev A)Revisions per ECOs, ECO Classification, and signature Approval MatrixRedlined changes may be approved and dated by assigned engineer when necessary for task in progress and then followed by appropriate ECO | Submit “as-built” drawings / documents to EDC (or other)Follow signature Approval Matrix for drawings / documents submissionTrack revisions with Letters; Start at Rev A (i.e. TZPZ-XX-M001 Rev A)Revisions per ECOs, ECO Classification, and signature Approval Matrix |

## 3.6 Revision / Changes to Documentation *{process to revise a document or hardware}*

### 3.6.1 Revising a Document

When a document needs to be revised, a Change Request should be filled out and brought before CCB for review. Any changes shall be tracked in the system. Once the change has been approved, the document is to be revised and released for final review and signoff. The final document is to be uploaded into the system under the Controlled Documents Folder.

### 3.6.2 Revising Hardware

An ECO is required when a hardware item needs to be revised after it has been baselined.

* Criteria for Changing the Revision of a Part:
* A part is revised when a modification is implemented that changes the parts Form, Fit or Function.
* Criteria for Changing a Part Number:
* A new part number is assigned when the functionality of an item is completely changed.

# 4.0 Configuration Control

*{procedures for changing baselines and processing change requests}*

## 4.1 Engineering Change Orders (ECOs)

When a document needs to be revised an ECO should be filled out and brought before CCB for review. These changes are tracked on the system. Once the change has been approved, the document is to be revised and released for final review and signoff. The final document is to be placed into the system under the Controlled Documents Folder. For Flight Hardware, the following documentation process is required. For Prototype Hardware, changes are required to be documented on the Change Requests Excel Sheet (CR).

## 4.2 Change Requests (CR)

A CR will be used to capture any changes to documents. The CCB will review all CRs to determine the type of change and assess the overall project impact. The CCB will recommend a disposition of either approval, approval with listed changes, withdrawn, or disapproval.

## 4.3 Non-Conformance Reports (NCRs)

An NCR is created in the event a discrepancy between stated project objectives and/or procedures is observed. NCRs will be created in {Folder Name} for all Flight Hardware Build and Development as appropriate for the mission scope and risk exposure (Refer to Risk Management Plan).

## 4.4 Travelers

If travelers are used they should adhere to the following process: Travelers shall be generated to maintain traceability of components, and end items (assemblies). Each component and end item shall have a unique traveler, which documents the part or item number and the history of the part or end item. The appropriate technical lead shall initiate the travelers and will coordinate with the CMR to obtain the proper form and traveler ID number.

## 4.5 Inspection Records

Records generated during the inspection of any Project product will be submitted to the CMR for inclusion in the documentation package. Copies of originals are acceptable if legible copies can be made from them. At NASA, the Quality Assurance (QA) group inspect and release a report of the findings. Entities outside of NASA shall comply with their institutions/organizations QA or equivalent.

# 5.0 Configuration Status Accounting *{captures how documents will be stored, controlled, and released}*

## 5.1 Document Storage *{types of information needed to be reported; reports to be produced; release process}*

Original documents and hard copies of documents should be stored under control of the CMR while the Project is active. At the conclusion of the project all Project documentation should be submitted to Center Control. The safekeeping and control of the documents becomes the responsibility of EDC.

# 6.0 CM Milestones *{define project milestones}*

Defines all relevant project milestones and describes how the milestones shall be met.

# Appendix A: Template for Project Configuration Management Plans (CMP)

The CMP Instructional Guide provides details to assist in external parties development of their project CMPs.

Note: Text in curly brackets “{text}” represent information to be captured (e.g., {Project Name}) when preparing the project-specific CMP, and italic text in curly brackets “*{text}”* represents guidance/information for a section being prepared and should be deleted from the CMP prior to release.

Page 1: Title page should include the title of the document, the project logo, document release date, and the document version.

Header should include the {Project Name} logo, {Project Name} Configuration Management Plan title, and document number (identifying number) and version (e.g., “Rev –“ to indicate baseline). Example as follows:

|  |  |  |
| --- | --- | --- |
| {Logo of Project} | ***{ABC Program}***Configuration Management Plan (CMP) | **{PROJECT DOC #}**{Rev} |

Footer should include the following statement: Distribution authorized by the {Project Name} Project Office and / or {Organization Name} and capture the page number.

Page 2: Document History Log for version control. Example as follows:

|  |  |  |
| --- | --- | --- |
| **Document****Revision** | **Effective****Date** | **Description** |
| Draft | MM/DD/YYYY | *{if recording draft versions}* |
| Rev - | MM/DD/YYYY | Initial Release |
| Rev A | MM/DD/YYYY | Change document name and corrected codes on pages x-z. |
|  |  |  |

Page 3: Signature page should include names, titles, and affiliations of individuals that prepared the document, and names, titles, and affiliation of individuals that reviewed and approved the document.

Page 4: Table of contents, list of tables, list of figures

The following is a suggested outline for the document. Tailor to your institution/organization structure as relevant.

1. Purpose *{High level overview of the Project CMP}*
	1. Scope
	2. Acronyms and definitions
2. Configuration Management *{High level overview of different responsibilities of various project positions; tailor to your institution/organization structure}*
	1. Organization and Responsibilities *{relationship of CM to life cycle of project}*
		1. Program Office *{group that defines the CM requirements in a Program Plan}*
		2. Project Office *{outlines how the CM requirements shall be met}*
		3. Configuration Management Representative(s) *{group responsible for managing the CM activities}*
		4. Change Control Board *{review board consisting of technical and administrative personnel}*
		5. Other Support *{as defined by the Project Office}*
3. Configuration Management Activities *{Overview regarding the identification system and numbering protocol for data management}*
	1. Hardware Identification *{labeling and numbering scheme}*
	2. Document Identification *{labeling and numbering scheme}*
	3. Document Control *{approval levels for drawings and/or documents}*
	4. Project Baseline *{starting point from which subsequent changes are made}*
	5. Documenting Revisions *{how to capture project documents, hardware, software, drawings, and schematics for subsequent design revisions}*
	6. Revision/Changes to Documentation *{process to revise a document or hardware}*
4. Configuration Control *{Procedures for changing baselines and processing change requests}*
	1. Engineering Change Orders
	2. Change Requests
	3. Non-Conformance Reports
	4. Travelers
	5. Inspection Records
5. Configuration Status Accounting *{captures how documents will be stored, controlled, and released}*
	1. Document Storage *{types of information needed to be reported; reports to be produced; release process}*
6. CM Milestones *{define project milestone}*

# Appendix B: NASA Standard Space Flight Project WBS Convention

 The following standard, adapted from figure B-2 from the NASA Cost Estimating Handbook, version 4.0 (<https://www.nasa.gov/sites/default/files/files/CEH_AppB.pdf>) only captures through level II and is not all inclusive. Each program/project shall tailor their project WBS accordingly. Additional WBS standards may be found in NPR 7120.8, Appendix K.

|  |
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# Appendix C: Project Standard WBS Elements Definitions (from NPR 7120.8, Appendix I)

|  |  |
| --- | --- |
| **Element 1 – Project Management:**  | The business and administrative planning, organizing, directing, coordinating, controlling, and approval processes used to accomplish overall Project objectives, which are not associated with specific hardware or software elements. This element includes project reviews and documentation (including NEPA), non-project owned facilities, and project reserves. It excludes costs associated with technical planning and management, and costs associated with delivering specific engineering, hardware and software products. |
|  |  |
| **Element 2 – Systems Engineering:** | The technical and management efforts of directing and controlling an integrated engineering effort for the project. This element includes the efforts to define the project vehicle - ground system, conducting trade studies; the integrated planning and control of the technical program efforts of design engineering, software engineering, specialty engineering, human rating, system architecture development, and integrated test planning, system requirements writing, configuration control, technical oversight, control and monitoring of the technical program, and risk management activities. Documentation Products include mission/system requirements document (MSRD); interface control documents (ICDs); Risk Management Plan and Verification and Validation (V&V) Plan. Excludes any design engineering costs.  |
|  |  |
| **Element 3 – Safety and Mission Assurance:** | The technical and management efforts of directing and controlling the safety and mission assurance elements of the project. This element includes design, development, safety assessment, review, and verification of practices and procedures and mission success criteria intended to assure that the delivered aero-craft/spacecraft, ground systems, mission operations, and payload(s) meet performance requirements and function for their intended lifetimes. This element excludes mission and product assurance efforts at partners/ subcontractors other than a review/oversight function, and the direct costs of environmental testing. Product assurance efforts should be distributed to each separate product/deliverable WBS element. |
|  |  |
| **Element 4 – Technology Payload Development:**  | This element includes the managing, directing, and controlling of the science investigation aspects, as well as leading, managing, and performing the technology demonstration elements of the Project. The costs incurred to cover the Principal Investigator, Project Scientist team members, and equivalent personnel for technology demonstrations are included. Specific responsibilities include defining the science or demonstration requirements; ensuring the integration of these requirements with the payloads, aero-craft/spacecraft; ground systems, mission operations; providing the algorithms for data processing and analyses; and performing data analysis and archiving. This element excludes hardware and software for on-board investigative instruments / payloads. |
|  |  |
| **Element 5 – Payload:**  | This element includes the equipment provided for special purposes in addition to the normal equipment (i.e. GSE) integral to the aero-craft or spacecraft. This includes leading, managing, and implementing the hardware and software payloads that perform the scientific experimental and data gathering functions placed on board the aero-craft or spacecraft, as well as the technology demonstration for the mission. |
|  |  |
| **Element 6 – Flight System** | The aircraft or spacecraft that serves as the platform for carrying payload(s), instrument(s), humans, and other mission-oriented equipment in space or air to the mission destination(s) to achieve the mission objectives. The aircraft or spacecraft may be a single aircraft or spacecraft or multiple crafts/modules (i.e. cruise stage, orbiter, lander, or rover modules). Each craft/module of the system includes the following subsystems as appropriate: Crew, Power, Command & Data Handling, Telecommunications, Mechanical, Thermal, Propulsion, Guidance Navigation and Control, Wiring Harness, and Flight Software. This element also includes all design, development, production, assembly, test efforts and associated GSE to deliver the completed system for integration with the launch vehicle and payload. This element does not include integration and test with payloads and other project systems. |
|  |  |
| **Element 7 - Mission Operations System:** | The management of the development and implementation of personnel, procedures, documentation and training required to conduct mission operations. This element includes tracking, commanding, receiving/processing telemetry, analyses of system status, trajectory analysis, orbit determination, maneuver analysis, target body orbit/ephemeris updates, logistics, and disposal of remaining mission resources at end-of-mission. The same WBS structure is used for Phase E Mission Operation Systems but with inactive elements defined as “not applicable”. However, different accounts must be used for Phase E due to NASA cost reporting requirements. This element does not include integration and test with the other project systems. |
|  |  |
| **Element 8 – Launch Vehicle / Services:**  | The management and implementation of activities required to place the aircraft or spacecraft directly into its operational environment, or on a trajectory towards its intended target. This element includes launch vehicle; launch vehicle integration; launch operations; any other associated launch services (frequently includes an upper-stage propulsion system), and associated ground support equipment. This element doesn’t include the integration and test with the other project systems. |
|  |  |
| **Element 9 – Ground System(s):** | The complex of equipment, hardware, software, networks, and mission-unique facilities required to conduct mission operations of the aero-craft or spacecraft systems and payloads. This complex includes the computers, communications, operating systems, and networking equipment needed to interconnect and host the Mission Operations software. This element includes the design, development, implementation, integration, test and the associated support equipment of the ground system, including the hardware and software needed for processing, archiving and distributing telemetry and radiometric data and for commanding the aeronautical or space craft. Also includes the operations, maintenance, and disposal of the project testbeds and project-owned facilities. This element does not include integration and test with the other project systems and conducting mission operations. |
|  |  |
| **Element 10 – Systems Integration and Testing:** | This element includes the hardware, software, procedures and project-owned facilities required to perform the integration and testing of the project’s systems, payloads, aircraft / spacecraft, launch vehicle / services, and mission operations.  |
|  |  |
| **Element 11 – Education and Public Outreach:** | Provide for the education and public outreach (EPO) responsibilities of NASA’s missions, projects, and programs in alignment with the Strategic plan for Education (Includes management and coordinated activities, formal education, informal education, public outreach, media support, and web site development). |

# Appendix D: Configuration Structure References

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| **M** Mechanical (Assembly, Fabrication Drawings & Part Numbers) |
|  |
| **XA** Agreements, Architectural and Engineering studies, Reviews such as CDR & Operational Readiness Review. (i.e PRR, PDR, CDR, etc) |
|  |
| **XB** Management / Financial Plans, Reports & Studies. (Project Management Plans, Schedules, cost estimates). |
|  |
| **XC**  Computer Software Listings & Codes |
|  |
| **XM**  Manuals & Instructions, Work Instructions - Procedures. |
|  |
| **XR**  Requirements Documents, (ICD), Specifications, Engineering Design  |
|  |
| **XS**  Safety/Hazard plans reports, studies and analyses |
|  |
| **XT**  Test Documentation (Plans, Acceptance, Verification / Validation, Results and Reports)  |
|  |
| **XV** Process Forms, Travelers, Verification / QA Docs. (etc). |

# Appendix E: Example CMP Documentation



# Appendix F: Reference Documents

*{Only include relevant references, do NOT include all of these, this is just an example}*

**AGENCY DOCUMENTS** *{Or organization documents}*

NPR 6000.1 Requirements for Packaging, Handling, and Transportation for Aeronautical and Space Systems, Equipment, and Associated Components

NPR 7120.5 NASA Space Flight Program and Project Management Requirements

NPR 7120.8 NASA Research and Technology Program and Project Management Requirements

NPR 7150.2 NASA Software Engineering Requirements

NPR 8000.4 Agency Risk Management Procedural Requirements

NPR 8621.1 NASA Procedural Requirements for Mishap and Close Call Reporting

NPR 8705.4 Risk Classification for Payloads

NPR 8715.3 NASA General Safety Program Requirements

NPD 8730.2 NASA Parts Policy

NPD 8730.5 NASA Quality Assurance Program Policy

NPR 8735.1 Exchange of Problem Data Using NASA Advisories and the Government-Industry Data Exchange Program (GIDEP)

NPR 8735.2 Management of Government Quality Assurance Functions for NASA Contracts

**NASA STANDARDS**

NASA-STD-0005 NASA Configuration Management (CM) Standard

NASA-STD-5005 Standard for the Design and Fabrication of Ground Support Equipment

NASA-STD-5006 General Welding Requirements for Aerospace Materials

NASA-STD-6008 NASA Fastener Procurement, Receiving Inspection, and Storage Practices for Spaceflight Hardware

NASA-STD-6016 Standard Materials and Processes Requirements for Spacecraft

NASA-STD 8709.20 Management of Safety and Mission Assurance Technical Authority (SMA TA) Requirements

NASA-STD 8709.22 SMA Acronyms, Abbreviations, and Definitions

NASA-STD-8719.13 NASA Software Safety Standard

NASA-STD-8739.1 Workmanship Standard for Staking and Conformal Coating of Printed Wiring Boards and Electronic Assemblies

NASA-STD-8739.2 Workmanship Standard for Surface Mount Technology

NASA-STD-8739.4 Crimping, Interconnecting Cables, Harnesses, and Wiring

NASA-STD-8736.6 Implementation Requirements for NASA Workmanship Standards

NASA-STD-8739.8 NASA Standard for Software Assurance

NASA-STD-8739.12 Metrology and Calibration

**CENTER DOCUMENTS**

APR 1000.1 Ames Dissenting Opinion Process

APR 1120.1 Ames Safety & Mission Assurance Technical Authority, and Health and Medical Technical Authority

APR 5100 Purchasing

APR 6410.1 Material Control, Handling, Preservation and Protection

APR 8705.1 System Safety and Mission Assurance

APR 8705.2 Safety and Mission Assurance Technical Authority

APR 8715.1 Ames Mishap and Close Call Reporting and Investigating/Contingency Plan (Chapter 4)

APR 8730.2 Ames Electrical, Electronic, and Electromechanical (EEE) Parts Control Requirements

APR 8735.1 Procedures for Preparation and Handling of NASA Advisories and Government-Industry Data Exchange Program (GIDEP) Alerts, Safe Alerts and Problem Advisories

APR 8735.3 Control of Nonconforming Products and Services

APR 8735.2 Deviation/Waiver (D/W) Process

QS 8739.1 ARC Program Plan for ESD Controls

EA-WI-027 Configuration Management Requirements

**PROGRAM DOCUMENTS**

*xxxx-xxxx-xxxx {Project Name} Project Management Plan*

*xxxx-xxxx-xxxx {Project Name} Systems Engineering Management Plan*

*xxxx-xxxx-xxxx {Project Name} Concept of Operations*

**INDUSTRY DOCUMENTS**

ANSI S20.20 Protection of Electrical and Electronic Parts, Assemblies, and Equipment (Excluding Electrically Initiated Explosive Devices)