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Configuration management and control for ESA space systems

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ABSTRACT

This specification contains the configuration data management and control programme requirements that are associated with and complementary to every other ESA discipline. It includes policies and procedures for the initialisation, preparation, review, approval, release, control and status accounting of all design definition and configuration identification data for spacecraft and associated equipment and software.

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. date	Page	Change Item	Approved DCR no.

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SECTION 1: CONFIGURATION MANAGEMENT AND CONTROL

1.1 INTRODUCTION

Configuration management and control provides, for all levels of management, the procedures and disciplines required to achieve effective control over the design and build status of all ESA spacecraft, associated equipment and their related software and is a basic requirement of ESA PSS-01-0.

This control is needed on a continuing basis from initial definition of the item to be controlled and throughout the period of use, including any maintenance, of the specific hardware or software. This control is provided by:

(a) A configuration identification baseline system which defines, through specifications, relevant documentation and associated data the requirements for all end items.
(b) A configuration control system which controls all changes to the identified configuration of items.
(c) A configuration accounting system which documents all changes to baseline configurations and maintains an accurate record of configuration change incorporation.
(d) A system of configuration verification, by audit and review, to ensure conformity between the end item and its appropriate design and qualification identification.

The requirements established herein are applicable to all organisations and contractors participating in ESA programmes.

1.2 APPLICABLE DOCUMENTS

The following document is applicable to the extent referenced in the contract:

ESA PSS-01-0 Product Assurance and Safety policy and basic requirements for ESA space systems.

1.3 DEFINITIONS

The definitions listed in Annex A shall apply.

1.4 OUTPUT DOCUMENTATION

The documents required as output from the configuration management and control programmes defined herein shall be as specified in the contract.

SECTION 2: CONFIGURATION MANAGEMENT AND CONTROL PROGRAMME

2.1 GENERAL

The contractor shall establish and implement an effective programme for configuration management and control. The programme shall have clear interfaces with project management and control, product assurance, design, development, production, integration and test functions. The programme shall include requirements and procedures for control, identification, verification and accounting of all hardware, software, related documentation and changes thereto.

2.2 ORGANISATION

A person shall be appointed as responsible for the contractor's configuration management and control programme for the project concerned. In this function, he shall act as the single-point contact for all matters relating to configuration and control for the project. An organigram shall form part of the Configuration Control and Management Plan.

2.3 PROGRAMME PLAN

Either as part of the Product Assurance Plan or as a separate subplan, the contractor shall prepare and submit to ESA a written document delineating his Configuration Management and Control Programme. The plan shall be in accordance with PSS-01-0.

2.4 AUDITS

The contractor shall plan, organise and periodically perform audits of the performance of his own and subcontractor's configuration control and management activities. Any deficiency discovered during an audit shall be satisfactorily closed so that all hardware, software, data, the related baseline and documentation is properly controlled.

2.5 SUBCONTRACTOR CONFIGURATION MANAGEMENT

The contractor shall define in his plan how the requirements of this document will be imposed on his subcontractors and suppliers. The contractor shall be responsible for the auditing and monitoring of his subcontractors' and suppliers' configuration and control system.

2.6 REPORTING

The contractor shall establish a reporting system and report on a regular basis to ESA. The documents forming the reports shall be as specified in the contract.

2.7 CHANGE AND INTERFACE CONTROL (CCB's)

The proper and timely functioning of the Configuration Control Boards (CCB's) shall be reviewed prior to all major project reviews and at intermediate points as described in the contractor's configuration management and control programme plan.

SECTION 3: CONFIGURATION MANAGEMENT

3.1 FUNCTION OF THE CONFIGURATION MANAGEMENT OFFICE (CMO)

A Configuration Controller belonging to a Configuration Management Office shall co-ordinate the following functions for an ESA project:

— the preparation, implementation and maintenance of the project configuration management plan;

— the establishment and assignment of end item configuration identification;

— the establishment of requirements (by reference to existing policies and procedures where these meet both the project requirements and the contractor interface) for the preparation and maintenance of drawings, specifications and supporting documentation and data lists for each configuration item;

— the establishment and operation of the approval and release authority for engineering documents;

— the establishment and operation of the Configuration Control Board;

— the establishment of subcontractor and supplier configuration management requirements;

— the establishment and distribution of configuration identification and status reports in conformance with the project requirements;

— the provision of adequate and accurate documentation support for design and other reviews;

— the effective processing of engineering changes and waivers through the approval cycle, and the release of documents for implementation;

— the preparation of engineering change proposals;

— the maintenance of records of contractual change authorisation;

— the establishment and operation of a comprehensive system for the correlation of the 'as-built' with the 'as-designed' configuration;

— the maintenance of effectivity control (model, types and serial numbers);

— the establishment and maintenance of an Interface Control System and documentation.

3.2 CONFIGURATION IDENTIFICATION

A documented system of configuration identification shall be established and implemented for the selection of configuration items and shall include all deliverable items. The selection shall also include other items where they may present potential control problems, e.g. 'special-to-purpose' test equipment.

A system for the identification numbering of all specifications, drawings, standards, procedures and other engineering data shall be established and shall be capable of uniquely identifying all items of hardware, software and documentation.

The system shall be such that a single item shall have a unique identifier (e.g. part and serial number). No two items shall have the same identifier. Hardware shall be permanently marked as a minimum with the following:

— configuration item number;
— serial number;
— part number with modification status;
— nomenclature of the item.

Software shall be permanently identified by the following:

— configuration item number;
— serial number (where applicable);
— software module number;
— version and revision identification;
— release date;
— nomenclature or designation.

3.3 CONFIGURATION DATA MANAGEMENT

A configuration data management system shall be established and described in the configuration management and control plan for the management of all released documentation, including documentation for software (see also Subsection 4.2). This shall encompass the issue of identification numbers, recording, maintenance, care, storage, retrieval and distribution of all documentation and changes released for the project.

3.4 INTERFACE MANAGEMENT

Interface management shall be implemented to identify and control the proceedings, duties and responsibilities between the parties (e.g. ESA) involved, the specific requirements for interface control documents (ICD's), the establishment of ICD's as design and build constraints, the requirements for reference to ICD's in appropriate specifications/drawings and interface change control. The schedule for the release of the ICD shall be comparable with project baseline schedules and design reviews; ICD's shall be completed before, and available for, the design reviews. Interface management shall be audited, monitored and reported in accordance with Subsections 2.4, 2.6 and 2.7 of this document.

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SECTION 4: CONFIGURATION CONTROL

4.1 GENERAL

The established system of configuration control shall provide for the control of baseline documentation and the procedures to be established for document change control by which change authorisations are systematically received, identified, evaluated, prepared, classified, approved and implemented. Waivers shall be recorded and reconciled against the baseline. The system shall establish the names of those individuals, organisations or suppliers who may originate a request for a change which will be acknowledged and acted upon for approval by the CMO. The system shall also define the procedures by which the request is submitted for consideration.

4.2 BASELINE CONTROL

A fundamental concept of configuration management is the establishment of 'baselines' to serve as a point of departure for the control of subsequent performance, design and build changes. Each project shall define baseline requirements, documented by approved specifications. The project shall also establish baseline status lists as part of each review package. Once baselines are defined, changes in requirements must be formally approved to ensure adequate consideration of their impact. The contractor shall also establish baselines at equipment and subsystem levels such that a consistent and coherent system baseline can be established. Following qualification, all changes and waivers shall be formally assessed against the final baseline. Nevertheless the contractor shall ensure that the chosen baselines are consistent with the critical milestones and phases of the project. The following functional baselines shall be established as a minimum to ensure proper design and hardware control and reconciliation:

- Design;
- Test readiness and post-test close-out;
- Qualification;
- Delivery/acceptance of item;
- Operational or flight readiness.

4.3 CONFIGURATION CONTROL BOARD (CCB)

A Configuration Control Board shall be established to review and control the design baselines. Changes to the baselines in the form of waivers and engineering change notices shall be submitted to the CCB for approval.

The CCB shall consist of members from project management (contracts, administration and configuration management and control), engineering, manufacturing and/or test and product assurance. The CCB members shall have sufficient authority to determine the approval status of the proposed waivers and changes.

The decisions of the CCB shall be documented in a report as a CCB directive to authorise the implementation of a change when approval is granted, or to notify the requester when approval is not given.

4.4 CHANGE EVALUATION

The evaluation of each proposed change shall include applicable aspects of physical and functional interfaces, performance, cost, schedule, operational effectiveness, safety, qualification, logistics, support equipment, training and multiple use of the affected configuration. The alternative of not making the change shall always be considered. Changes shall be limited to those necessary to correct design deficiencies or offer significant benefits related to operational support, life-cycle and cost savings or to prevent slippage in contractual schedules.

Engineering drawings shall not be changed to avoid Material Review Board (MRB) processing of nonconforming items, except when the change is accepted for all subsequent production of the item concerned.

4.5 CLASSIFICATION OF CHANGES

All engineering change documents and subsequent documents which implement changes shall be marked with their class, as defined in the contract, and the interchangeability status.

4.6 CHANGE IMPLEMENTATION

All changes shall be approved prior to implementation. Contractual classifications and definitions of changes, together with the level of implementation authority, shall be defined in the contract.

4.7 INTERCHANGEABILITY

All changes that affect the product shall be identified as either causing noninterchangeability or not affecting the interchangeability of the item concerned. An interchangeable item is one which:

(i) possesses such functional and physical characteristics as to be equivalent in performance, reliability and maintainability to another item of similar or identical purpose; and
(ii) is capable of being exchanged for other items without selection for form, fit or function and without alteration of the items themselves, or of adjoining items, except for adjustment.

Noninterchangeable items, which by definition are those which do not meet the above criteria, shall be clearly identified by the re-identification of all affected documentation up to the level where interchangeability is re-established.

Items which are noninterchangeable or, through waiver or change implementation, become noninterchangeable shall not bear the same part or configuration item number as those items that are interchangeable.

4.8 WAIVERS

A system for the preparation and presentation of waivers shall be established, together with procedures and formats for their control, approval and implementation.

Where during the design, the design implementation or the qualification or acceptance testing, the requirements of the applicable specifications cannot be met, a waiver against that requirement shall be requested.

The waiver shall clearly identify the definition of the noncompliance, the justification for its acceptability and the resulting constraints and control to be implemented.

Waivers may apply to a single item, event or occurrence or may be granted against some or all items designed to meet the requirement. The waiver shall clearly state the range of serial numbers of the affected CI's. If the applicability of the waiver is for all items, then the configuration control system shall provide the possibility for a requirement change and an update of the related documents at all levels.

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SECTION 5: CONFIGURATION STATUS ACCOUNTING

5.1 GENERAL

A system of configuration status accounting which encompasses the systematic release, recording, correlation and reporting of information needed for the effective management of the configuration identification of the 'as-designed' standards shall be established and implemented by means of a Configuration Item Data List (CIDL).

5.2 CONFIGURATION ITEM DATA LIST (CIDL)

The CIDL shall contain, as a minimum, the following:

assembly drawings, interface control drawings, drawing family tree, circuit diagrams, equipment specifications, subsystem specifications, system specifications, test procedures, test plan, EEE parts list, materials list and process list.

5.3 BASELINE STATUS

A system listing which defines the 'as-built' status and the reconciliation with the 'as-designed' baseline shall be established before approval and acceptance of the baselines and shall include a Certificate of Compliance.

5.4 REPORTING

The person responsible for the project configuration management shall co-ordinate the establishment and maintenance of appropriate reports to satisfy the requirements for deliverable configuration management and control data, as well as for internal control. The system established shall provide procedures for:

- the input to and maintenance of data bases to permit the preparation of reports;
- the submission of configuration status reports to ESA or to a contract-designated agency;
- the collation, preparation and distribution of internal reports for configuration management;
- the acceptance of inputs from associated contractors for collation into prepared reports.

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ANNEX A

DEFINITIONS

AUDIT

A planned, purposeful and comprehensive examination and verification of management objectives, assignment of duties, delegation of responsibilities, methods of operation, facilities, hardware and software systematically conducted either randomly or periodically, on any contractor, subcontractor, supplier or manufacturer.

CHANGE

An alteration in the configuration of an end item or items delivered, to be delivered, or under development after the formal establishment of its configuration identification.

CONFIGURATION CHANGE CONTROL

The systematic evaluation, co-ordination, approval or disapproval and implementation of all changes in the configuration of an item and its related requirements, design or performance.

CONFIGURATION ITEM NUMBER

The unique reference number by which an item can always be identified. It is assigned in the definition phase as soon as the item is identified. The configuration item shall be controlled by a specification and a unique assembly drawing.

CONFIGURATION MANAGEMENT

A discipline applying technical and administrative direction and surveillance to:

- identifying and documenting the functional, physical and environmental characteristics of an item.
- recording, reporting and controlling change-processing and implementation status.
- verifying the 'as-built' standard of an item as documented by product assurance against the design standard.

INTERCHANGEABLE

An interchangeable item is one which possesses such functional and physical characteristics as to be equal in performance, reliability, maintainability and safety to another item of similar or identical purpose and is capable of being exchanged for the other item:

— without selection for fit or performance, and
— without alteration of the item itself or of the adjoining items, except for adjustment, where design provision has been made for such adjustment.

WAIVER

A written authorisation to accept a design or items which, before or during production or after having been submitted for review, inspection or test, are found to depart from specific requirements.