MINISTÉRIO DA CIÊNCIA, TECNOLOGIA, INOVAÇÕES E COMUNICAÇÕES INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS	**PROJETO:** **EQUARS**

PRODUCT ASSURANCE PRELIMINARY REQUIREMENTS - SPACE SEGMENT

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AUTORES			
NOME	**DIVISÃO**	**DATA**	**ASSINATURA**
Cristiane Mariano Zavati Silva	CGCEA	19/9/19	
Ana Paula S. S. Rabello	CGETE/SESEQ	19/09/2019	
Lucas Lopes Costa	CGETE/SESEQ	19/09/2019	
Sergio Norio Itami	CGETE/SESEQ	19/09/2019	

REVISORES			
NOME	**DIVISÃO**	**DATA**	**ASSINATURA**
Cristiane Mariano Zavati Silva	CGCEA	19/9/19	

APROVADO POR			
NOME	**DIVISÃO**	**DATA**	**ASSINATURA**
Leandro Toss Hoffmann	CGETE/DIDSS	19/9/2019	
Inaldo Soares de Albuquerque	CGETE/SESEQ	19/9/2019	

REVISÕES				
REV.	**DATA**	**MUDANÇAS/ N. PÁG.**	**AUTOR**	**APROVADO POR**

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1 INTRODUCTION

1.1 SUBJECT

This document establishes the Product Assurance Requirements to the space segment of EQUARS mission. It encompasses the disciplines: Product Assurance, Quality Assurance; Dependability; Radiation; Software Product Assurance; and EEE Components and Materials, Mechanical Parts and Processes.

This document is applied to INPE and to the suppliers.

1.2 SCOPE

This Product Assurance document shall be applied to all space segment projects from system level down to parts and components including both, on board hardware and software. Also shall be applied to design, development, production, assembling, integration and test, and launch campaign phases [REF-17].

1.3 DOCUMENTATION

1.3.1 Applicable Documents (AD)

This chapter gives the highest-level specifications and requirements, which have mandatorily to be applied in PA arrangements.

[AD-1] EQUARS-1140-PLN-001-A: Plano de Gerenciamento de Riscos;

[AD-02] ETE/SEQ-ET-001: Requisitos de Controle de Partes Mecânicas, Materiais e Processos do Grupo de Engenharia do Produto;

[AD-03] ECSS-Q-ST-40C: Space product assurance - Safety;

[AD-04] ECSS-Q-ST-40-02C: Space product assurance - Hazard Analysis;

[AD-05] ECSS 12300: European Preferred Part List and Its Management;

[AD-06] ECSS-Q-ST-30-11C Rev 1: Space Product Assurance - Derating EEE Component;

[AD-07] ECSS-Q-ST-80C Rev 1: Space Product Assurance - Software Product Assurance;

[AD -08] ECSS-Q-ST-60 Rev 2: Space Product Assurance - EEE Components;

[AD-09] MIL-STD-202F: Test Methods for Electronic and Electrical Components Parts;

[AD-10] MIL-STD-750C: Test Methods for Semiconductor Devices;

[AD-11] MIL-STD-883C: Test Methods and Procedures for Microelectronics;

[AD-12] MIL-M-38510H: Microcircuits, General Specification For;

[AD-13] MIL-S-19500G: Semiconductor Devices, General Specification For;

[AD-14] ESA-PSS-01-70: Material and Processes Selection and Quality Control for ESA Spacecraft and Associated Equipment;

[AD-16] ECSS-M-ST-40C Rev 1: Configuration and information management; and

[AD-15] ESA-PSS-01-701: Data for Selection of Space Materials.

1.3.2 Reference Documents (RD)

This chapter provides the list of procedures, rules and standards on which the project is based for implementing the PA Requirement. It refers in particular to the guide for scientific projects, the relevant MPMs (Management Procedures and Methods) or standards.

[RD-01] SESEQ-Q-HBK-00047 - Guia de elaboração das análises da predição de confiabilidade, redução de esforços (derating) e FMEA/FMECA para partes elétricas, eletrônicas e eletromecânicas de satélites do INPE;

[RD-02] ECSS-Q-ST-10-04C: Space Product Assurance - Critical Item Control;

[RD-03] ECSS-S-ST-00-01C: ECSS System - Glossary of Terms;

[RD-04] IEEE –STD–730.1 – 1995: IEEE Guide for Software Quality Assurance Planning;

[RD-05] IEEE–STD-730 – 2014: IEEE Standard for Software Quality Assurance Processes;

[RD-06] MIL-HDBK-217 F: Reliability Prediction of Electronic Equipment;

[RD-07] IEEE-STD-1074 - 2006: Standard for Developing a Software Project Life Cycle Process;

[RD-08] ESA - PSS.01-0: Basic Requirements for Product Assurance of ESA Spacecraft and Associated Equipment;

[RD-09] ESA - PSS.01-20: Quality Assurance of ESA Spacecraft and Associated Equipment;

[RD-10] MIL - STD-756B: Reliability Modeling and Prediction;

[RD-11] MIL - STD-1629A: Procedure for Performing a Failure Mode, Effects and Criticality Analysis;

[RD-12] ECSS-Q-ST-20C Rev 1 - 2013 - Space Product Assurance - Quality Assurance;

[RD-13] ECSS-Q-ST-30C – Space product assurance - Dependability;

[RD-14] ECSS-Q-ST-30-02C Space product assurance Failure modes, effects (and criticality) analysis (FMEA/FMECA); and

[RD-15] MIL-STD-1629A Military Standard Procedures for Performing a Failure mode, effects and criticality analysis.

[RD-16] ECSS-Q-ST-10-09 – Space product assurance – Nonconformance control system

[RD-17] EQUARS-3000-TS-1 - Mission Assurance Requirements

[RD-18] TOR-2007(8546)-6018 Rev B - Mission Assurance Guide

[RD-19] TOR-2010(8591)-18 Rev Jun, 2010 - Mission Assurance Program Framework

[RD-20] EXP-RQMT-0003 Rev. A - SMall EXplorers (SMEX) - Mission Assurance Requirements (MAR)

[RD-21] ECSS-E-ST-10C - Space Engineering: System Engineering General Requirements

[RD-22] EQUARS-3400-TS-001 – Safety Requirements

1.4 ACRONYMS AND DEFINITON

1.4.1 Acronyms list

CI	Critical Item
CIL	Critical-item List
DRD	Document Requirements Definition
EGSE	Electrical Ground Support Equipment
EIDP	End Item Data Package
ETA	Estação Terrena de Alcântara
ETC	Estação Terrena de Cuiabá
ETE	Engenharia e Tecnologia Espacial
FM	Flight Model
GGPSw	Grupo da Garantia do Produto de Software
GSE	Ground Support Equipment
MIP	Mandatory Inspection Point
MMPP	Material, Mechical Parts and Processes
NCR	Nonconformance Report
NRB	Nonconformance Review Board
PA	Product Assurance
PAM	Product Assurance Manager
QA	Quality Assurance
QM	Qualification Model
SEQ	Serviço de Engenharia da Qualidade
SJC	São José dos Campos
SPA	Software Product Assurance
TRB	Test Review Board
TRRB	Test Readiness Review Board
VCB	Verification Control Board
VCD	Verification Control Document

1.4.2 Lista de Definições

Acceptance

According to ECSS-S-ST-00-01C [RD-03], act by which the customer agrees that the product is designed and produced according to its specifications and the agreed deviations and waivers, and it is free of defects when delivered by the supplier. Acceptance is a process that part of the verification process which demonstrates that the product meets specified acceptance margins.

Review

According to ECSS-M-ST-10-01C [RD-03], project reviews are examinations of the technical status of a project and associated issues at a particular point in time. Their primary purpose is to provide a comprehensive assessment of the project status against targets and requirements. Through independent participation, they give additional support to the project concerned at crucial stages and give the responsible management confidence in the technical progress being achieved. Additionally, reviews can identify potential lessons learned.

Supplier

According to ECSS-S-ST-00-01C [RD-03], the term Supplier will refer to any organization or person that provides a product as part of a business agreement.
NOTE: A supplier can be internal or external to the customer organization.

Customer-Supplier Model ECSS [RD-21]

The production of space systems calls for the cooperation of several organizations that share the common objective of providing a product that satisfies the customer's needs (performance within cost and schedule constraints).
All space project actors are either a customer or a supplier, or both.
In its simplest form, a project can comprise one customer with just one supplier; however, most space projects comprise a number of hierarchical levels, where:

- the actor at the top level of the hierarchy is the top level customer;
- the actors at intermediate levels of the hierarchy are both supplier and customer; and
- the actors at the lowest level of the hierarchy are suppliers only.

Customer [RD-03].

organization or person that receives a **product** as part of a **business agreement.**
NOTE: customer can be internal or external to the supplier organization.

Supplier [RD-03].

organization or person that provides a **product** as part of a **business agrement.**
NOTE: supplier can be internal or external to the customer organization.

2 PRODUCT ASSURANCE MANAGEMENT

2.1 SCOPE OF PA MANAGEMENT

The prime objective of Product Assurance is to ensure that space products accomplish their defined Mission Assurance Requirements [RD-17].

Product Assurance Management ensures the integration of activities from the Product Assurance disciplines, as defined in the ECSS standards.

The requirements specified in clause 2.2.1 (PA Programme Planning) address the following aspects:

- Definition of a Product Assurance organization with the allocation of adequate resources, personnel and facilities,
- Definition of Product Assurance requirements for lower tier suppliers,
- Definition of a Product Assurance Plan describing the Product Assurance programme and how it fulfils project objectives and requirements.

The requirements specified in clause 2.2.2 (PA Programme Implementation) address the following aspects:

- Management and control of the PA tasks performed by the PA disciplines.
- Progress reporting of all Product Assurance matters.
- Management of audits, critical items, nonconformances and alerts [TBD-1].
- Support to the risk management, in coordination with the Project Management functions.
- Support to the documentation and data control, quality records and to configuration management.
- Lower-tier supplier control for ensuring implementation of PA requirements by the suppliers.

2.2 REQUIREMENTS

2.2.1 PRODUCT ASSURANCE PLANNING

2.2.1.1 PRODUCT ASSURANCE ORGANIZATION AND RESPONSIBILITIES

2.2.1.1.1 ORGANIZATION

a. The supplier shall identify the personnel responsible for implementing and performing PA activities.

b. The supplier shall assign a project PA manager reporting to the project manager.

NOTE: The project PA manager is referred to as “PA manager” in the rest of this document.

c. The PA manager shall have organizational authority to establish and implement a product assurance programme in accordance with the project product assurance requirements.

d. The PA Manager shall act as the focal point of contact for Product Assurance matters.

2.2.1.1.2 RESPONSIBILITY AND AUTHORITY

a. The supplier shall define and document the responsibilities and the interfaces of the PA functions, either external or internal, involved in a project.

b. The delegation of product assurance tasks by a supplier to a lower tier supplier shall be done in a documented and controlled way, with the main supplier retaining the responsibility towards the customer.

2.2.1.1.3 RESOURCES

a. The supplier shall identify the PA resources needed to implement the PA programme.

b. The supplier shall provide resources capable to perform the PA tasks identified in the PA programme.

c. Reviews and audits of the product assurance programme, of processes or of product shall be carried out by personnel not directly involved in the work being performed.

2.2.1.2 PA MANAGEMENT INTERFACES

a. The PA manager shall interface with project management, ensuring that the contractual provision and schedule planning for the definition and phasing of PA activities are met.

b. The PA manager shall interface with risk management, configuration management, engineering, verification and AIT for the definition and execution of tasks in which PA activities are involved.

c. The PA manager shall interface with the customer regarding all Product Assurance matters.

d. The PA manager shall interface with lower-tier suppliers regarding all Product Assurance matters.

2.2.1.3 PA PLAN

a. The supplier shall prepare, maintain and implement a plan of the PA activities in accordance with the customer PA requirements.

b. The Product Assurance Plan shall be prepared in conformance with [TBD-2].

c. The Product Assurance Plan shall be submitted to the customer for approval.

2.2.2 PA PROGRAMME IMPLEMENTATION

2.2.2.1 PRODUCT ASSURANCE MANAGEMENT

a. The PA manager shall ensure that PA disciplines are organized at the beginning of the project according to customer contractual requirements.

b. The PA manager shall ensure that the PA disciplines perform the tasks described in the PA Plan in line with the project schedule.

c. The PA manager shall ensure that the outputs produced by the PA disciplines are consistent and complete, and delivered in line with the project schedule.

d. The PA manager shall ensure the application of processes defined in applicable project plans and documents.

e. The PA manager shall control the quality of his supplier's products by:
   - ❖ issuing product assurance requirements applicable to the supplier;
   - ❖ ensuring the implementation of the PA requirements by the supplier.

f. The PA manager shall ensure that PA contributions to verification are defined and provided.

g. The PA manager shall ensure that a qualification programme is defined, approved and maintained by the relevant organization.

h. The PA manager shall ensure that the qualification programme is implemented and the qualification results are recorded, evaluated and documented.

i. The PA manager shall ensure that a QSL (Qualification Status List).

j. The PA manager shall review and approve the achieved qualification status.

k. The PA manager shall recommends to approval the product acceptance during the Acceptance or Delivery Review.

   NOTE: The PA manager approval is based on the outputs of the Acceptance or Delivery Review.

2.2.2.2 PA REPORTING

a. The supplier shall report on the status and progress of the product assurance programme implementation, according to PA Plan.

b. The PA report shall include at least the following items for the reporting period:

   - ❖ Progress and accomplishment of each major product assurance task including resolved and new problems, future planning of major activities and events
   - ❖ Status of PA reviews, Audits and MIPs, Waiver requests, Nonconformances (minor and major), Critical items (including mitigation action plan status), Qualification status, EEE component status, Material and processes status.

c. The PA progress report may be part of the project progress report.

2.2.2.3 PROJECT PA AUDITS

a. The supplier shall be subjected to INPE's audits at any time, with previous notification.

   Note: INPE reserves the right to audit any subcontractor or supplier at any time, giving previous notification to the audited.

b. The supplier shall perform audits on his own performance to verify the implementation and effectiveness of the provisions defined in the PA plan approved by the main contractor.

c. The supplier shall establish and maintain an audit plan for the project, designating the lower tier suppliers to be audited, the current status and the schedule for auditing.

d. In addition to the planned audits, extra audits shall be performed when necessary to overcome failure, consistent poor quality, or other problems.

e. The supplier shall plan and perform audits using established and maintained procedures.

2.2.2.4 CRITICAL ITEMS CONTROL AND PA INTERFACES TO PROJECT RISK MANAGEMENT

a. The supplier shall establish a critical items control programme.

b. The PA manager shall identify and evaluate critical items in support of the overall project risk management activities.

c. The PA manager shall ensure that a critical item control programme is implemented to eliminate or mitigate associated risks.

2.2.2.5 DOCUMENTATION AND DATA CONTROL

a. The PA manager shall ensure that the applicable issues of all documents and data are available at all locations where activities required for the implementation of the PA programme are performed.

b. The PA manager shall ensure that invalid or obsolete documents and data are removed from all points of issue or use.

c. The PA manager shall identify the project documents requiring approval including those requiring approval by PA.

2.2.2.6 QUALITY RECORDS

a. The supplier shall establish and maintain quality records to provide objective evidence of complete and successful performance of all PA discipline tasks and to demonstrate compliance with requirements.

2.2.2.7 PA CONTRIBUTION TO CONFIGURATION MANAGEMENT

a. The PA manager shall verify during CCB (Configuration Control Boards) the suitability for release of drawings, plans, specifications, procedures and changes.

b. The PA manager shall ensure that the as-designed status is defined and released prior to manufacturing;

c. The PA manager shall ensure that the as-built documentation is properly defined, identified and maintained in order to reflect approved modifications;

d. The PA manager shall ensure that items delivered comply with the as-built documentation.

3 QUALITY ASSURANCE

3.1 INTRODUCTION

The prime objective of Quality Assurance (QA) management is to ensure that a QA programme for projects covering mission definition, design, development and production of space systems is established, maintained and implemented.

All QA requirements are specified through definition and implementation of adequate methods and procedures.

Personnel whose performance determines or affects product quality are trained and certified in accordance with project needs.

3.2 REQUIREMENTS

3.2.1 REQUIREMENTS PRECEDENCE

a. INPE shall establish precedence in the event of any conflict among or between requirements.

3.2.2 QA MANAGEMENT REQUIREMENTS

3.2.2.1 QUALITY ASSURANCE PLAN

a. The supplier shall prepare, maintain and implement a QA plan.

b. The QA plan shall be submitted to the customer for approval.

3.2.2.2 PERSONNEL TRAINING AND CERTIFICATION

a. The supplier shall establish a documented training programme for the personnel whose performance determines or affects product quality.

b. Personnel shall be retrained as a result of unsatisfactory performance, changes in techniques or required skills, or interruption of work performance as defined in the training programme.

c. Personnel performing or evaluating special processes shall be trained and certified according to standards accepted by the customer.

d. Personnel performing non-destructive testing and evaluation shall be trained and certified according to standards accepted by the customer.

e. The supplier shall maintain records of the training and certification available for review by INPE.

3.2.3 QA GENERAL REQUIREMENTS

3.2.3.1 CRITICAL-ITEMS CONTROL

a. The supplier shall implement Critical-items control.

3.2.3.2 NONCONFORMANCE CONTROL SYSTEM

a. The supplier shall implement a nonconformance control system.

3.2.3.3 ACCEPTANCE AUTHORITY MEDIA

a. The supplier shall establish and maintain a documented stamp control system to ensure the correct and legitimate use of all fabrication and inspection stamp.

b. Stamp shall be used to:
   - signify the completion of operations and processes, and
   - indicate inspection performance at source and incoming inspection, in process inspection and tests, final inspection, end point testing, storage and shipment.

c. The use of stamp shall be restricted to authorized personnel as identified in the stamp control system.

d. Stamp shall be traceable to individuals responsible for their use.

3.2.3.4 TRACEABILITY

a. The supplier shall ensure that a bidirectional and unequivocal relationship between parts, materials or products and associated documentation or records is established and maintained.

b. The supplier shall be capable to trace data, personnel and equipment related to procurement, manufacturing, inspection, test, assembly, integration and operations activities.

c. The supplier shall be capable to trace backward the locations of materials, parts, sub-assemblies.

d. The supplier shall be capable to trace forward the locations of materials from raw stock.

e. The supplier shall establish controls to ensure that:
   - ❖ identification numbers are assigned in a systematic manner.
   - ❖ identification numbers of scrapped or destroyed items are not used again.

f. identification numbers, once allocated, are not changed, unless the change is authorized by the customer. The supplier shall establish traceability controls according to Programme rules documents.

3.2.3.5 METROLOGY AND CALIBRATION

a. The supplier shall control, calibrate and maintain inspection, measuring and test equipment, whether owned by the supplier, on loan, or provided by the customer to demonstrate the conformance of product to the specified requirements.

b. The supplier shall use equipment in a manner which ensures that measurement uncertainty is known and is consistent with the specified measurement capability.

c. The supplier shall include in the calculations of all measurements the total error in the measurement process attributable to the cumulative error from the calibration chain, measuring equipment and those contributed by personnel, procedures and the environment.

d. The supplier shall record the basis for the calculation of the cumulative errors as specified in requirement item ‘c’ above.

e. The, supplier shall identify, calibrate and adjust all inspection, measuring and test equipment and devices that can affect product quality at prescribed intervals, or prior to use, against certified equipment.

f. The supplier shall establish, document and maintain calibration procedures, including details of equipment type, identification number, location, frequency of checks, check method, acceptance criteria and the action to be taken when results exceed the specified accuracy.

g. The supplier shall ensure that the inspection, measuring and test equipment is capable of the specified accuracy and precision.

h. The supplier shall identify inspection, measuring and test equipment with a suitable indicator or approved identification record to show the calibration status.

i. The supplier shall maintain calibration records for inspection, measuring and test equipment.

j. The supplier shall assess and document the validity of previous inspection and test results when inspection, measuring or test equipment is found to be out of calibration.

k. The supplier shall ensure that the environmental conditions are suitable for the calibrations, inspections, measurements and tests being carried out.

l. The supplier shall ensure that inspection, measuring and test facilities, including both test hardware and test software are protected against adjustments, which can invalidate the calibration setting.

m. The supplier shall ensure that the inspection, measuring and test equipment is handled, preserved and stored such that the accuracy and fitness for use is maintained.

n. The supplier shall check the test hardware or test software used for inspection to prove that it is capable of verifying the acceptability of the product prior to release for use during production and installation, and recheck it at specified intervals.

NOTE: 1 Examples of test hardware are: jigs, fixtures, templates and patterns.
NOTE: 2 Test aids such as test leads, break-out boxes, mains leads and similar items are not subject to the entire set of requirements defined in this clause, but are validated in a way appropriate to their usage.

o. The supplier shall establish the extent and frequency of test hardware or test software checks and shall maintain records as evidence of control.

p. The supplier shall make the measurement design data available to the customer upon request.

3.2.3.6 HANDLING, STORAGE, TRANSPORTATION AND PRESERVATION

3.2.3.6.1 HANDLING

a. The supplier shall prevent handling damage during all phases of manufacturing, assembly, integration, testing, storage, transportation and operation.

NOTE: Possible prevention measures are:

- ❖ protection of items during handling,
- ❖ handling devices, or
- ❖ procedures and instructions.

3.2.3.6.2 STORAGE

a. The supplier shall place the following items in secure storage areas:
1. incoming materials,
2. intermediate items needing temporary storage, and

3. end items before shipping.

NOTE: Security of the storage is defined according to specific customer requirements.

b. The supplier shall place the following items in designated segregated areas:
   1. limited life materials,
   2. suspended limited life materials,
   3. nonconforming items awaiting NRB disposition,
   4. scrapped items,
   5. items designated to be stored separately for health or safety reasons.

c. Each segregated area shall be identified and labeled for its intended use.

d. The supplier shall maintain control over acceptance into and withdrawal from storage areas.

e. The supplier shall maintain records to ensure that all stored items are within the usable life limits, controlled and retested, and to provide traceability within the storage or segregated area.

f. The supplier shall ensure that no deterioration, damage or unexpected performance degradation occur to stored items due to storage conditions.

3.2.3.6.3 transportation

[TBD-3]

3.2.3.6.4 PRESERVATION

a. The supplier shall ensure that items subject to deterioration, corrosion or contamination through exposure to any environmental elements are preserved by methods that ensure maximum protection consistent with life and usage.
   NOTE Examples of such environmental elements are: air and moisture.

3.2.3.7 STATISTICAL QUALITY CONTROL AND ANALYSIS

3.2.3.7.1 GENERAL

a. Statistical quality control applications, when statistically significant with respect to the product characteristics and to quantities produced shall be submitted to the customer for approval.

3.2.3.7.2 SAMPLING PLANS

a. When sampling plans are used the supplier shall define and justify the following:
   1. sample size, sample selection methods and criteria for inspection severity,
   2. acceptance / rejection criteria, and
   3. screening of rejected lots.

b. The supplier shall maintain records of the sampling tests, together with the identification of the characteristics to which sampling is applied.

3.2.4 QA REQUIREMENTS FOR DESIGN AND VERIFICATION

3.2.4.1 DESIGN RULES

3.2.4.1.1 GENERAL

a. The supplier shall ensure that design rules concerning the suitability of the product to be manufactured, reproduced, inspected, tested and operated are applied in the design phase.

3.2.4.1.2 PRODUCIBILITY

a. The supplier shall ensure that the product is designed such that it can be produced with the specified level of quality.

3.2.4.1.3 REPEATABILITY

a. The supplier shall ensure that the product is designed such that its performances and characteristics can be reproduced consistently over different models and serial production.

3.2.4.1.4 INSPECTABILITY AND TESTABILITY

a. The supplier shall ensure that the product is designed such that it can be inspected and tested under representative conditions, for production, Assembly, Integration and Verification (AIV) and operational environment.

3.2.4.1.5 OPERABILITY

a. The supplier shall ensure that the product is designed such that it can be operated in accordance with programme constraints and requirements, throughout its whole life cycle including handling, storage, transportation, integration and operations.

3.2.4.2 VERIFICATION

3.2.4.2.1 GENERAL

a. The supplier shall ensure that requirement verification is performed progressively, as each stage of the project is completed, and provides the organized base of data upon which qualification and acceptance is incrementally declared.

b. The supplier shall ensure that top-down requirement allocations and bottom-up requirement verifications are complete and consistent.

c. The supplier shall ensure that a process for tracking requirements and verification of results is established and maintained during the whole project life cycle.

d. The supplier shall ensure that verification methods are adequate and consistent with the type and criticality of the requirements.

e. The supplier shall ensure that appropriate reference to the verification documentation is recorded and status updated at project reviews up to final acceptance.

3.2.4.2.2 DESIGN AND VERIFICATION ANALYSIS

a. The supplier shall ensure that the objectives of the analysis are defined in relation with the development logic defined in the verification plan.

b. The following items shall be identified:
   1. reference of the configuration item definition under analysis;
   2. environmental constraints considered in the analysis;

3. basic assumptions, analysis methods, mathematical models.

3.2.4.2.3 DESIGN REVIEWS

a. The supplier shall ensure that design reviews are conducted in accordance with project requirements and written procedures.

3.2.4.3 QUALIFICATION PROCESS

3.2.4.3.1 QUALIFICATION

a. The supplier shall ensure that all configuration items and their constituent items, either off-the-shelf or specifically designed, are properly qualified with margins consistent with the application and use environment.

b. The supplier QA shall review and approve the qualification plan, which is a subset of the Verification Control Document (VCD).

c. The supplier QA shall review and approve the qualification results, which are a subset of Verification Control Document (VCD).

d. The supplier QA manager shall ensure that the qualification process is monitored by a Verification Control Board (VCB).

e. For equipment with a heritage, partial or full, in terms of qualification, in the early phase of the contract, a dedicated review, Equipment Qualification Status Review (EQSR) shall be held.
NOTE: Equipment Qualification Status Review (EQSR).

3.2.4.3.1.1 QUALIFICATION BY SIMILARITY

a. Qualification by similarity with an identical or similar product shall be justified by providing evidence that the new application is within the limits of the previously qualified design.

b. Any difference in definition with respect to the reference product and any difference in the required qualification tests shall be identified.

c. The need for complementary qualification tests shall be analyzed and the decision justified and submitted to the customer for approval.

d. For this purpose the supplier shall:
   1. evaluate the as-designed or as-built configuration and related nonconformances,
   2. ensure that qualification requirements and qualification ranges are compatible with project requirements,
   3. ensure that qualification test results meet the requirements and any nonconformances are available for evaluation, and
   4. ensure that a logbook of the selected model is available for review.

3.2.4.3.1.2 QUALIFICATION TESTING

a. The product used for qualification testing shall be produced in accordance with a full and clearly identified manufacturing and inspection file.

b. To obtain authorization to initiate qualification tests the supplier shall demonstrate that:
   1. the qualification model is fully representative of the flight model and any differences have been analyzed to evaluate their effect on the qualification status;

2. inspection and test requirements are expressed in an unambiguous and quantified manner including:
   (a) test sequence;
   (b) test conditions;
   (c) test standards, if any;
   (d) applicable test levels, durations and tolerances;
   (e) accuracy in measurement.

3.2.4.3.1.3 QUALIFICATION STATUS

a. The supplier shall report the qualification status in conformance with the "Qualification status list".

3.2.4.3.1.4 MAINTENANCE OF QUALIFICATION

a. The supplier shall monitor record and periodically report to the customer the qualification status of all deliverable items together with the progress of the qualification programme.

b. Before re-using existing qualification model for test, the model shall be assessed regarding representativeness of the design, build and history relevant to new flight model design status.

c. All changes, deviations and anomalies shall be assessed for their impact on the qualification status and be agreed with the customer in case of impact.

3.2.4.3.2 DESIGN CHANGES

a. The supplier shall ensure that all design changes and modifications are identified; documented; reviewed; and approved by the customer, before their implementation.

3.2.5 QA REQUIREMENTS FOR PROCUREMENT

3.2.5.1 SELECTION FOR PROCUREMENT SOURCES

3.2.5.1.1 GENERAL

a. The supplier QA shall participate in the approval and the selection of procurement sources.
NOTE: The selection of procurement sources for EEE components.

b. The supplier shall establish and implement systematic controls to ensure the adequacy and quality of all purchased and subcontracted parts, components, materials, equipment, software and services.

c. The Programme Manager shall distinguish between activities to be implemented on already developed items and those on items that have to be designed and fabricated for the project, including the evaluation and selection of procurement sources and review of procurement documents prior to start of procurement.

3.2.5.1.2 SELECTION CRITERIA

a. The supplier shall select its suppliers on the basis of one of the following criteria:
   1. The supplier has been approved by the final customer, and has a current approval to furnish items or services of the type and quality level being procured.
   2. The supplier is furnishing, or has furnished, items or services of the type and quality level being procured under other contracts with the final customer.

3. The supplier has demonstrated continuous capability to furnish items or services of the type and quality level being procured, supported by objective documentation.
4. Supplier's capability of satisfying business agreement requirements is demonstrated by a pre-award audit by the relevant customer.

NOTE to item 1: Third party certification (for instance against ISO 9001) can be also considered.

b. The supplier shall document and maintain on file results of supplier selection process.

3.2.5.1.3 RECORD AND LIST OF PROCUREMENT SOURCES

a. The supplier shall establish and maintain records of all procurement sources involved in business agreement performance.

b. The supplier shall submit to the customer, upon request, the list of procurement sources, including all the information in the records of item 'a' above, for information.

3.2.5.2 PROCUREMENT DOCUMENTS

a. The supplier shall ensure that supplies are identified and that all applicable requirements are defined in the procurement documents.

b. The supplier shall ensure that requirements to those contained in lower tier procurement documents are traceable.

c. The procurement documents shall contain, by statement or reference:
   1. comprehensive technical descriptions of the items and services to be procured,
   2. details of the applicable requirements, such as requirements for preservation, packaging, marking, shipping, accompanying documentation and provisions for limited-life items,
   3. details of QA activities to be performed, such as inspection and test characteristics, records and reports,
   4. details of supplier's QA activities at source, and
   5. special acceptance conditions.

3.2.5.3 SURVEILLANCE OF PROCUREMENT SOURCES

a. The supplier shall exercise surveillance over the activities carried out by lower level suppliers during business agreement performance.

b. The surveillance programme shall address audits, reviews and mandatory inspection points.

c. The supplier shall define the type and extent of surveillance by reviewing the following criteria:
   1. Testing or inspections cannot be accomplished by the supplier.
   2. Verification tests are destructive in nature and the quality cannot be verified solely by inspection or test at supplier's facility.
   3. Supplies are designated for direct shipment from source to a customer site or the using site.
   4. Manufacturing and AIV of complex equipment or subsystems.
   5. Past performance or quality history of the lower level supplier is marginal.
   6. Functional criticality and technical complexity of the supplies.
   7. The degree of responsibility placed on the procurement source.

d. The supplier shall ensure that each of their suppliers implements surveillance on their lower level suppliers, in accordance with the same criteria.

e. All surveillance activities shall be documented.

f. Surveillance may be delegated by the customer to third parties.

3.2.5.4 RECEIVING INSPECTION

3.2.5.4.1 GENERAL

a. The supplier shall ensure that all incoming supplies, including documentation and packaging, whether delivered on their own premises or elsewhere, conform to the requirements.

b. The supplier shall perform inspections in accordance with established procedures and instructions, to ensure that quality level is properly determined.

c. Receiving inspectors shall have available the procurement documents, specifications, drawings and any other document relevant to incoming supplies.

3.2.5.4.2 RECEIVING INSPECTION ACTIVITIES

a. Receiving inspection activities shall include:
   1. verification of the packaging conditions and of the status of environmental sensors,
   2. visual inspection of the delivered items,
   3. verification of correct identification and, where appropriate, configuration identification for conformance to the ordering data,
   4. verification of the evidence of inspection and tests performed by the supplier and associated documentation,
   5. verification of the performance of supplier's source inspection, when required,
   6. performance of inspections and tests on selected characteristics of incoming supplies or test specimens submitted with the supplies,
   7. identification of the shelf life of limited-life items,
   8. identification of the inspection status and physical separation of the supplies in the receiving inspection area according to the following categories:
      (a) items for which the receiving inspection has not been completed;
      (b) conforming items;
      (c) nonconforming items.
   9. prevention of unauthorized use of uninspected items,
   10. identification of the items to be released for production with conformance status and traceability data to be recorded in manufacturing documents,
   11. maintenance of receiving inspection records.

3.2.5.4.3 CUSTOMER FURNISHED ITEMS

a. Receiving inspection of items supplied by the customer shall consist of the verification of identity and integrity after transportation and any additional inspections and tests specified in the business agreement.

3.2.5.4.4 RECEIVING INSPECTION RECORDS

a. The supplier shall maintain receiving inspection records to ensure traceability and the availability of historical data.

3.2.6 QA REQUIREMENTS FOR MANUFACTORING, ASSEMBLY AND INTEGRATION

3.2.6.1 PLANNING OF MANUFACTORING, ASSEMBLY AND INTEGRATION ACTIVITIES AND ASSOCIATED DOCUMENTS

a. The supplier shall document the planning of manufacturing, assembly and integration operations and inspections in the manufacturing plan or flow chart for the product, including the sequence of operations and associated inspections and tests.

b. The planning shall include the identification of MIPs, together with the reference to the procedures by which the various activities are performed and the required cleanliness levels, temperature and humidity of the facilities.

c. Instructions shall ensure that the activities proceed in an orderly manner and according to the planned sequence.

d. The supplier shall issue and maintain manufacturing, assembly, integration and inspection documents in accordance with established and released procedures.

e. The QA organization shall review and approve such documents, and any modifications thereof, to ensure that they include or refer to:
1. Identification of the item to be manufactured or equipment to be used.
2. Configuration data, including parts lists, drawings, changes and specifications.
3. Identification of the production and inspection equipment to be used for the manufacturing, assembly and integration of the item.
4. Identification of critical characteristics.
5. Detailed definition, by description or reference, of manufacturing, assembly, integration, inspections and test operations to be performed, and special conditions to be maintained.
6. Provisions for inspections and tests to be witnessed by customer representative.
7. Accept or reject criteria (with tolerances) and workmanship standards.
8. Details of sampling inspection procedures to be used, if any.
9. Detailed procedures for the activities to be performed.

f. Only “first off” shop travellers shall be reviewed unless subsequent travellers incorporate a significant change of inspection requirements or order of events.

g. The supplier shall provide a detailed up-to-date listing of all support documents and instructions, such as: drawings, procedures, process specifications, and instruction sheets used in the fabrication, control, and inspection of the materials and articles.

3.2.6.2 MANUFACTORING READINESS REVIEWS

a. The supplier shall provide resources to allow INPE's MRR (Manufacturing Readiness Review), prior to starting the manufacture of the qualification (EQM or QM) and flight models (FM).

b. The manufacturing readiness review shall evaluate the following aspects:
1. status of product definition and requirements, differences with the status of the qualification model, and impacts of these differences;
2. status of manufacturing, assembly, inspection and test documentation, differences with the status of the qualification model, and impacts of these differences;
3. verification the status of manufacturing processes, including special processes qualification;

4. implementation of dispositions for risk reduction, as defined by risk assessment, into the manufacturing, assembly, integration, inspection and test procedures;
5. availability of personnel and of specified materials and parts, production, measuring and inspection equipment, and calibration status, when relevant;
6. cleanliness of facilities, with respect to the specified cleanliness levels;
7. facility temperature and humidity with respect to requirements
8. implementation of controls to ensure that only conforming items, materials and components are released and used.

3.2.6.3 CONTROL OF PROCESSES

3.2.6.3.1 GENERAL

a. The supplier shall monitor all processes used for manufacturing, assembly and integration, and enforce all applicable process requirements.

b. The supplier shall ensure that all manufacturing processes are covered by documented process specifications or standards.

c. Process specifications shall include QA provisions, methods for inspection and test, number of samples, accept or reject criteria.

d. Process witness samples shall be stored in controlled conditions.

3.2.6.3.2 SPECIAL PROCESSES

a. The supplier shall establish and implement procedures and controls for special processes, to ensure that:
   1. Special processes are qualified and validated for the intended application.
   2. Personnel who perform or inspect special processes are trained and certified.
   3. Materials, equipment, computer systems and software, and procedures involved in the performance of the special process are validated and monitored.
   4. Coordination is maintained with the cognizant engineering function to ensure proper selection of the non-destructive or destructive methods for the evaluation of process performance.

3.2.6.3.3 STATISTICAL PROCESS CONTROL

a. When applicable, statistical methods for process control shall be used for early detection of significant variations in manufacturing processes, in order to determine, analyse and eliminate the causes of undesirable variations.

3.2.6.4 WORKMANSHIP STANDARDS

a. The supplier shall employ workmanship standards throughout all phases of manufacturing, assembly and integration, to ensure acceptable and consistent workmanship quality levels.

b. Workmanship standards shall identify acceptance or rejection criteria.

c. Physical samples or visual aids shall be reviewed and agreed by the customer when they are used for the purpose of acceptance or rejection of items.

3.2.6.5 MATERIAL PARTS AND CONTROL

a. The supplier shall ensure that only conforming items are released and used, and that those not required for the operation involved are removed from work operation areas.

b. Items having limited-life or quality degradation shall be marked to indicate when life was initiated and when the useful life expires.

c. Sensitive items shall be processed or manufactured, inspected and tested in a controlled environment to prevent degradation.

3.2.6.6 EQUIPMENT CONTROL

3.2.6.6.1 TOOLING

a. The supplier shall make provisions for accountability, identification and maintenance of manufacture, assembly and integration tooling.

b. Manufacture, assembly and integration tooling shall be checked for its accuracy.

c. The QA organization shall approve tooling prior to use.

d. The approval shall be marked and recorded.

e. Tools shall be checked for accuracy at adequate intervals.

f. Tools shall be submitted to re-approval once modified.

g. Tools shall be properly stored to prevent misuse, damage and deterioration.

h. Unnecessary tools shall be removed from working areas.

i. History records shall be kept of all tooling.

3.2.6.6.2 EQUIPMENT FOR COMPUTER-AIDED MANUFACTURING

a. The supplier shall ensure that computer-aided techniques and data for processing and machining are validated prior to use and controlled during their use in manufacturing.

b. The supplier shall ensure that provisions are made for the testing, approval and configuration control of the software involved and prevention of its being changed without permission.

3.2.6.7 CLEANLINESS AND CONTAMINATION CONTROL

3.2.6.7.1 GENERAL

a. The supplier shall establish controls for cleanliness of spacecraft hardware and facilities, and the limitation of sources of contamination.

3.2.6.7.2 CLEANLINESS LEVEL

a. Contamination-sensitive items shall be cleaned, controlled and maintained to the required cleanliness levels.

b. The required cleanliness levels of flight hardware shall be indicated on documents controlling the manufacture, assembly, integration and test of the items.

3.2.6.7.3 CLEANLINESS MATERIALS AND METHODS

a. The supplier shall develop detailed methods for attaining the cleanliness levels specified for the hardware.

3.2.6.7.4 CONTAMINATION CONTROL

a. Contamination shall be minimized by operating in clean working areas and by proper handling, preservation, packaging and storage.

b. Contamination-sensitive items fabricated or processed in contamination-controlled environments shall be inspected, tested, modified or repaired in identical or cleaner environments, unless specific precautions are taken to protect the items concerned from contamination.

c. Specific protection means shall be implemented to protect contamination-sensitive items when they are integrated in a higher level of assembly.

3.2.6.7.5 CLEANLINESS OF FACILITIES

a. Fabrication, assembly and integration of contamination sensitive items shall be conducted in facilities that provide cleanliness levels compatible with the specified product cleanliness.

3.2.6.8 INSPECTION

a. Inspection and tests shall be planned at the points of the manufacturing, assembly and integration flow where maximum assurance for correct processing and prevention of unrecoverable or costly nonconformances can be obtained.

b. All identified critical characteristics shall be inspected as defined in the critical-item control programme.

c. Self-inspection by the operators performing the associated manufacturing, assembly and integration activities shall not be considered sufficient for critical characteristics.

d. Among the inspections and tests as part of the manufacturing, assembly and integration flow, mandatory inspection points (MIPs) shall be performed with participation of the customer.

e. MIPs shall be agreed with the customer on the basis of a list prepared by the supplier.
NOTE This list can be part of another deliverable document.

f. MIPs shall be selected in accordance with the criteria as defined below, when one or more of the following conditions apply:
1. When maximum visibility of quality is given.
2. When critical processes are performed.
3. Where the next step of the manufacturing sequence:
(a) is irreversible, or
(b) makes the item difficult and costly to disassemble for inspection, or
(c) renders the location inaccessible for inspection.
4. When the item, once installed in the next higher assembly damages by its failure the higher assembly.
5. When previous failure history of the item indicates a need for inspection.
6. When a potential adverse impact on the properties and integrity of the end product could result, owing to the criticality or complexity of the manufacturing step.
7. When testing or critical inspections cannot be accomplished by the supplier.
NOTE For example, environments or test equipment not available at supplier's facility.

8. When verification tests are destructive in nature and the quality cannot be verified solely by inspection or test at the supplier's facility.
9. When manufacturing and AIV of complex equipment or subsystems is planned.
NOTE: For example, for payloads.
10. When past performance or quality history of the lower level supplier is marginal.
11. When an item is going to final inspection.

g. Criteria "f" above, from 7 to 10, shall be considered together with the criticality and complexity of the supplies and the supplier's experience with the lower level supplier.

h. A MIP shall require an invitation with the agreed notice before the event, and the participation of the customer, or their written agreement to proceed without their participation.

i. The supplier shall make provisions for a positive identification of the inspection and test status of any items at any stage of the manufacturing, assembly and integration cycle, starting from the incoming inspection up to shipping of the end item.

j. MIP information shall include as a minimum:
   1. Purpose and subject of the inspections,
   2. Criteria for the selection,
   3. Notification period,
   4. MIP identifier,
   5. MIP description,
   6. Reference of procedures necessary to perform the MIP, and
   7. MIP location in the manufacturing and Inspection flow chart or the AIV flow chart.

k. KIP/MIP shall be performed by Supplier's Product Assurance.

l. INPE's PA shall decide for the execution of the MIP, if required.

3.2.6.9 SPECIFIC REQUIREMENTS FOR ASSEMBLY AND INTEGRATION

3.2.6.9.1 CONTROL OF TEMPORARY INSTALLATIONS AND REMOVALS

a. The supplier shall ensure the control and identification of flight items which are temporarily removed or non-flight items which are temporarily installed to facilitate assembly, integration, testing, handling or preservation of the end item.

b. The control shall be initiated upon installation or removal of the first temporarily installed or removed item and be maintained through delivery and use of the end item.

c. The supplier shall establish and maintain records of temporary installations and removals.

d. The control shall comprise the definition of colored tags for identifying temporarily installed items to prevent their being incorporated in the final flight configuration.

3.2.6.9.2 LOGBOOKS

a. The supplier shall prepare and maintain system, subsystem and equipment logbooks for all operations and tests performed on the item.

b. Equipment logbooks shall start with the first test after assembly.

c. Subsystem and system logbooks shall follow-on from the individual equipment logbooks to form a full record.

d. The logbook shall accompany the hardware whenever it is placed in the custody of another organization.

3.2.6.10 MANUFACTORING, ASSEMBLY AND INTEGRATION RECORDS

a. The supplier shall establish and maintain manufacturing, assembly and integration records to provide all manufacturing, assembly, integration and inspection data required for traceability.

3.2.6.11 ELECTROSTATIC DISCHARGE CONTROL (ESD)

a. The supplier shall establish and maintain an ESD protection programme during the design, manufacture, test and storage/transport of flight hardware.

b. The supplier shall provide an ESD control plan.

3.2.7 QA REQUIREMENTS FOR TESTING

3.2.7.1 GENERAL

a. The Project Manager shall provide the necessary planning functions for all integration and test (functional, physical and environmental) programmes, including as a minimum:
a) orderly and timely testing at the earliest opportunity throughout the integration and test phase;
b) coordination and sequencing of test conducted at successive levels of assembly to minimize unnecessary testing.

b. The Project Manager shall establish and implement a documented inspection, testing and surveillance programme throughout the integration and test phase.

3.2.7.2 TEST FACILITIES

a. The supplier shall ensure that test facilities, either internal or external, conform to the project specified requirements.

3.2.7.3 TEST EQUIPMENT

a. The supplier shall ensure that computer-aided testing techniques and data are validated prior to use and controlled during their use in testing.

b. The supplier shall ensure that provisions are made for testing, approval and configuration control of the software involved and prevention of its being tampered with.

c. The supplier shall ensure that test equipment is designed such that their correct operation can be verified without having to apply them to the test item.

3.2.7.4 TEST DOCUMENTATION

3.2.7.4.1 TEST PROCEDURES

a. The supplier shall ensure that tests are performed in accordance with documented procedures.

b. The QA organization shall review and approve test procedures.

3.2.7.4.2 TEST REPORTS

a. The supplier shall ensure that all tests are comprehensively documented in test reports, and that they include, as a minimum:
   1. reference to the applicable test procedure, and description of the deviations from it during the actual testing,
   2. test data records and evaluation, and
   3. summary of test results.

b. The QA organization shall review and approve test reports.

3.2.7.5 TEST PERFORMANCE MONITORING

a. On the basis of an analysis of the test plan, the QA organization shall define within the test plan the way to monitor the performance of test activities, to ensure the adherence to the test procedures, and that any deviations are properly documented and treated.

b. Test witnessing by QA personnel shall be considered when manual intervention is performed, at the setting-up, start and end of continuous fully automated test sequences, or when no automatic recording of test parameters or results is available.

c. All testing activities related to critical characteristics as identified in the critical-items control programme shall be verified by QA.

d. Self-verification by the operators performing the test activities shall not be considered sufficient for critical characteristics.

e. Testing activities or results to be subject to QA verification shall be identified as such in the relevant test procedure.

f. Testing shall be subject to the requirements for the control of hazardous operations.

g. Where safety of personnel or damage to items or associated test equipment is possible, QA personnel shall have the authority to stop the test.

3.2.7.6 TEST REVIEWS

a. The supplier shall ensure that reviews are performed before and after defined points during qualification or acceptance tests.

b. Test Reviews shall be performed.

c. The QA organization shall be part of the formal boards established for the review of readiness for testing and testing accomplishment.

3.2.8 QA REQUIREMENTS FOR ACCEPTANCE AND DELIVERY

3.2.8.1 ACCEPTANCE AND DELIVERY PROCESS

a. The supplier shall establish a formal acceptance process for all deliverable items, at any contractual level, to ensure that conformance of the items to be delivered is fully assessed and documented.

b. The supplier shall ensure that the preparation of the items for delivery and the physical delivery itself are performed in such a way that degradation is prevented.

3.2.8.2 END ITEM DATA PACKAGE

a. Every flight equipment and spare equipment shall be delivered with their specific End Item Data Package (EIDP), which shall contain:
   • The acceptance tests reports;
   • The certificate of conformance;
   • The non-conformances list;
   • The granted Waivers/Deviations;
   • The As-Built documentation;
   • The equipment's Logbook (e.g., registers of: operation time, connectors mate/demate and transport);
   • The equipment Handbook (integration, testing, handling, storage and operation).

b. The EIDP shall constitute the basis for formal acceptance reviews.

c. EIDPs shall be maintained and integrated into higher level EIDPs during subsystem or system integration and testing.

3.2.8.3 DELIVERY REVIEW BOARD (DRB)

a. The supplier shall ensure that a DRB is convened prior to the delivery of equipment, separately assembled subsystems, test equipment or handling equipment for higher level activities.

b. The DRB functions at system level shall be fulfilled by the final acceptance review and chaired by the customer.

c. The DRB shall be composed, at least, of the following members:
   1. Representatives of the receiving organization:
      (a) Project manager, or authorized representative, as chairman;
      (b) PA manager, or authorized representative;
      (c) Engineering or design manager, or authorized representative.
   2. Submitting supplier's representatives:
      (a) Project manager, or authorized representative;
      (b) PA manager, or authorized representative;
      (c) Engineering or design manager, or authorized representative.
   3. Higher level customers' representative(s), as observers (not required for separate subsystems).

d. The customer reserves the right to attend DRBs at any lower level as an observer, so shall be given due notice of such a DRB meeting.

e. The DRB shall be responsible for authorizing the shipment of the items under acceptance, certifying in writing that:
   1. the items conform to the contractual requirements and to an approved design configuration;
   2. the items are free from material and workmanship deficiencies;
   3. all nonconformances are closed-out, or corresponding plans, compatible with the delivery, are accepted;
   4. the relevant EIDP is complete and accurate.

f. Delivery shall only be authorized by the DRB.

g. For the delivery a certificate of conformity, be made available and signed by the supplier.

3.2.8.4 PREPARING FOR DELIVERY

3.2.8.4.1 PACKAGING

a. The supplier shall ensure that packaging materials, methods, procedures and instructions provide for protection of items while at the supplier's plant, during transportation, and after their arrival at destination.

3.2.8.4.2 MARKING AND LABELING

a. The supplier shall ensure that appropriate marking and labeling for packaging, storage, transportation and shipping of items are performed in accordance with the applicable specifications.

3.2.8.5 DELIVERY

3.2.8.5.1 SHIPPING CONTROL

a. The supplier shall ensure that the items to be shipped from their plant are inspected before release and found to be complete, adequately preserved and packaged, correctly marked and accompanied by all the required documentation.

b. Accompanying documentation shall include the EIDP and, attached to the outside of the shipping container, the handling and packing or unpacking procedure and any relevant safety procedures.

3.2.8.5.2 TRANSPORTATION

a. The supplier shall make provisions for the prevention of damage to items during transportation.

4 DEPENDABILITY

4.1 DEPENDABILITY PROGRAMME

The dependability programme shall be implemented by means of a systematic process for specifying requirements for dependability and demonstrating that these requirements are achieved.

The supplier shall coordinate, implement and integrate the dependability programme management with the PA programme management.

The supplier shall develop, maintain, and implement a dependability plan for all project phases in conformance with the DRD in Annex C - ECSS-Q-ST-30C Rev.1 [AD-05].

NOTE: The dependability plan can be included in the PA programme plan.

The dependability plan shall address the dependability requirements applicable to the project.

NOTE: The dependability requirements in the scope of PA are defined herein. Other dependability requirements are stated in the project specifications.

Responsibilities for carrying out all dependability tasks within each phase of the lifecycle shall be defined.

4.1.1 Dependability risk assessment and control (TBC-1)

As part of the risk management process implemented on the project, the Dependability engineer shall be responsible for identifying and reporting dependability associated risks.

NOTE: ECSS-M-ST-80 describes the risk management process.

4.1.2 Dependability critical items (TBC-2)

Dependability critical items shall be identified by dependability analyses performed to support the risk reduction and control process performed on the project.

A Dependability Critical Item List shall be established and maintained throughout the project. The Dependability Critical Item List shall be submitted to the PA manager to be included in the PA Critical Items List.

The following specific criteria shall be used for selecting Dependability Critical Items:

1. items identified as single-point failure with at least a failure consequence severity classified as catastrophic, critical or major;
2. all items that have failure consequences classified as catastrophic;
3. products that cannot be checked and tested after integration, limited–life products, products that do not meet, or cannot be verified as meeting - applicable maintainability requirements;
4. items with high predicated failure rates, critical performance or critical function;
5. items that do not meet parts stress requirements.

Items that satisfy the dependability critical items selection criteria shall be included on the Dependability Critical Items List (DCIL).

The DCIL shall be maintained and communicated to PA manager.

The DCIL shall be documented in accordance with ANNEX E - SESEQ-Q-HBK-00047 [RD-01].

Dependability critical items, as part of the Critical Items List, shall be subject to risk assessment and critical items control in conformance with ECSS-Q-ST-10-04.

The dependability aspects shall be considered during the entire verification process for dependability critical items until closeout.

4.1.3 Design reviews (TBC-3)

The supplier shall ensure that all dependability data for a design review are presented to the customer in accordance with the project review schedule.

All dependability data submitted shall indicate the design baseline and shall be coherent with all other supporting technical documentation.

All design changes shall be assessed for their impact on dependability and a reassessment of the dependability shall be performed.

4.2 DEPENDABILITY ENGINEERING (TBD-4)

4.2.1 Integration of dependability in the project

4.2.2 Dependability requirements in technical specification

4.2.3 Dependability design criteria

4.2.4 Involvement in testing process

4.2.5 Involvement in operational aspects

4.3 DEPENDABILITY ANALYSES (TBC-5)

Dependability analyses shall be performed on all space projects throughout the project life cycle to support the dependability tasks and specified requirements.

Dependability analyses shall be performed initially to contribute to the definition of the conceptual design and the system requirements.

The analyses shall be performed to support the conceptual, preliminary and detailed development and optimization of the design, including the testing phase that leads to design qualification.

Dependability analyses shall be implemented in order to:

1. ensure conformance to reliability, availability and maintainability requirements, and
2. identify all potential failure modes and technical risks with respect to functional requirements that can lead to non-compliance to the dependability requirements,
3. provide inputs to risk management process implemented on the project, and
4. provide inputs to the project critical item control process.

The results of dependability analyses shall be incorporated into the design justification file in order to support the rationale for the selection of the design solution, and the demonstration that the design meets the dependability requirements.

Dependability analyses shall be conducted on all levels of the space system and be performed in respect of the level that is being assessed i.e. System, Subsystem and Equipment levels.

NOTE: The main purpose of all dependability analyses is to improve the design by providing timely feedback to the designer, to reduce risks within the processes used to realize the products and to verify conformance to the specified dependability requirement.

4.3.1 Reliability Analyses

4.3.1.1 Reliability Prediction

The Reliability Prediction shall be performed in accordance with SESEQ-Q-HBK-00047 [RD-01] and used with the following objectives:

1. to predict the in-service reliability of a product;
2. to provide failure probability data.

NOTE: The reliability data sources and methods used in the Reliability Prediction shall be as stablished at SESEQ-Q-HBK-00047 [RD-01].

The Reliability Prediction shall be for worst case operating and environmental conditions.

NOTE: The thermal worst case operating and environmental conditions shall be extracted from the thermal analysis.

The Reliability Prediction shall consider all components of the equipment.

NOTE 1: The components considered for the Reliability Prediction includes all mechanical, electrical and combinations. (eg. solder points, printed circuit board, mechanical parts, mechanisms, etc.)

NOTE 2: Part failure data sources shall be presented in the applicable documentation and available to the customer.

NOTE 3: Supplier shall identify equipment types, parts quality levels and quantities to carry out this task.

The Reliability Prediction shall present the mathematical expressions corresponding the Reliability Block Diagram used in the reliability prediction.

The assumptions used in the Reliability Prediction shall be documented.

For (TBD) a Reliability Prediction using the parts stress method, MIL-HDBK-217F [RD-06], shall be presented.

The Reliability Prediction shall be documented in accordance with SESEQ-Q-HBK-00047 [RD-01].

4.3.1.2 Reliability Block Diagram

Reliability Block Diagram shall be prepared to show interdependencies among all functional blocks of the equipment in the overall operational phase.

NOTE 1: The purpose of the reliability block diagram is to show the various series/parallel block combinations that result in product success.

NOTE 2: The functional blocks shall be structured based on the equipment functional architecture.

The Reliability Block Diagram shall provide a concise and complete model of equipment elements.

The Reliability Block Diagram shall reflect the current design baseline and shall be coherent with all other technical documentation.

The Reliability Block Diagram shall be drawn so that each element or function employed in the product can be clearly identified. All blocks shall be configured in series, parallel, standby, or combinations as appropriate.

The Reliability Block Diagram shall be documented.

NOTE: The Reliability Block Diagram can be part of the Reliability Prediction Report.

For (TBD) a Reliability Block Diagram shall be presented.

4.3.2 Parts Stress Analysis (PSA)

Part derating shall be implemented in conformance with ECSS-Q-ST-30-11C Rev 1 [AD-06] to assure that the stress levels applied to all EEE parts are within the limits.

Part stress analyses shall be performed at part level to verify that the derating rules have been implemented.

For (TBD) a Part Stress Analysis shall be presented.

4.3.3 Failure Modes and Effects Analyses (FMEA)

The FMEA shall be performed in accordance with SESEQ-Q-HBK-00047 [RD-01].

NOTE: The supplier shall prepare, maintain, and control Failure Modes and Effects Analyses (FMEA).

All potential failure modes shall be identified and classified according to the severity (Section 6.2.4.3) of their consequences.

The analysis shall document the worst-case effects and identify those functions/capabilities and mission phases for which the specified effects apply.

When any design changes are made, the FMEA shall be updated and the effects of the new failure modes introduced by the changes shall be assessed.

Provisions for failure detection and recovery actions shall be identified as part of the FMEA.

As part of the FMEA, potential failure propagation shall be assessed.

The assumptions used to perform the FMEA shall be documented.

4.3.3.1 Level of Analysis

For (TBD) the Functional FMEA shall be presented.

NOTE 1: The equipment FMEA shall be prepared than the analysis shall be integrated to the system at the functional level.

NOTE 2: The analysis shall identify failure causes to a level sufficient to allow elimination of the cause by design action.

For (TBD) the Hardware FMEA shall be presented.

NOTE: The Hardware FMEA shall be prepared to the component level.

4.3.3.2 Mission Phases and Operational Modes

All mission phases and related operational modes shall be addressed by the FMEA.

NOTE: The mission phase and operational modes which failure mode is assumed to occur shall be presented at the FMEA worksheet.

4.3.3.3 Severity Categories (TBC-7)

* COMMENT: Table 1 shows an example of severity categories. These categories shall be evaluated by Program Systems Engineer and Program Manager.

Table 1 Severity Categories

Severity Level	Severity Category	Dependability Effects
1	Catastrophic	Failure propagation
2	Major	Loss of mission
3	Minor	Major mission degradation
4	Negligible	Minor mission degradation or any other effect

4.3.3.4 FMEA report

The FMEA shall be documented in accordance with SESEQ-Q-HBK-00047 [RD-01].

4.3.4 Availability Analyses (TBD-8)

4.3.5 Maintainability Analyses (TBD-9)

5 SAFETY

According document [RD-22].

6 PARTS, MATERIALS AND PROCESSES (PMP)

6.1 SCOPE

This chapter defines the criteria and requirements for the preparation and implementation of the Parts, Materials and Processes Plan to be established for the space program project.

The implementations of this plan a total management of the selection, application, procurement, control and standardization of PMP to:

- Reduce PMP failures at all levels of assembly;
- Improve procurements of small quantities of parts;
- Reduce program costs;
- Assure parts, materials and processes reliability.

6.2 POLICIES

The PMP Plan of the supplier shall consider the following policy items:

- Maximization of the use of qualified and space-proven parts, materials and processes;
- Rationalization and documentation, or standardization wherein applicable, of the approach of all project groups in the selection of parts, materials and processes;
- Coordination of the procurement: the Main Contractor shall procure parts through the use of common specifications, common purchase agreements and unified management.

6.3 REQUIREMENTS

6.3.1 GENERAL

The supplier shall establish a Parts, Materials, and Processes Control Board (PMPCB) to coordinate and manage the program's PMP control. The supplier shall designate a PMPCB Chairperson responsible for the planning and execution of all PMPCB actions and decisions.

The PMPCB´s supplier shall delegate to the PMPCB´s sub-supplier the responsibility for provide evidence of conformity regarding PMP but the final decision of conformance is from PMPCB´s supplier. The sub-suppliers shall follow all the PMP´s requirements imposed for the supplier, including the designation of a Chairperson responsible for the planning and execution of all PMPCB actions and decisions.

The designated Chairperson shall have the authority and adequate resources to perform the management, PMP engineering, procurement, quality assurance and administrative functions required.

Qualified personnel shall be allocated to his team, in sufficient number to permit the timely completion of all tasks.

The management structure shall provide clear and definitive interfaces between PMP group, the project team, sub-suppliers, and any procurement agency utilized for the execution of the Plan.

6.3.2 PMPCB (PARTS, MATERIALS AND PROCESS CONTROL BOARD)

The PMPCB´s supplier shall be constituted by PMP specialists including representatives from EEE, Product Engineering, Radiation, Dependability, Safety, Software and Quality Assurance Groups.

The PMPCB decisions shall not change the contractual requirements of the program.

The PMPCB shall include a government member or designated representative (as the Program Manager) who retains the right of review and disapproval of PMPCB decisions while present at the PMPCB meeting or within a mutually agreed upon period.

The minimum responsibility to the PMPCB shall be:

- Ensures Parts, Materials and Processes are qualified for the mission and meet contractual requirements;
- Approves Requests for Approval to Approved Parts Lists;
- Prepares the Program for documentation, standardization and control PMP selection;
- Approves PMP Program;
- Ensures flow down and enforcement of PMP requirements to suppliers and sub suppliers;
- Approves suppliers Parts, Materials and Processes Lists;
- Acts as focal point on PMP matters;
- Reviews and dispositions program PMP nonconformance;
- Reviews and approves the initiation and closure of Parts, Materials and Process purges;
- Reviews and dispositions advisories and alerts;
- Provides support to Destructive Physical Analyses (DPA).

6.3.3 PMP PLAN

The PMP Plan shall describe in detail the proposed approach, methods, procedures and organization that the Main Contractor, and the Contractor, will adopt to be compliant with the requirements described herein.

The PMP Plan shall include, as a minimum, the detailed description of the following items:

- Organizational structure, responsibility and authority descriptions, management approach;
- Program for documentation, or standardization when applicable, and control PMP selection;
- PMP evaluation and qualification approach;
- PMP testing level and lot acceptance;
- PMP quality assurance activities including incoming inspection;
- Requirements on, and system for the control of lower level suppliers, procurement
- agents (if any);

- System and schedule of audits and surveillance for control of supplier and procurement agency (if any);
- Coordinated procurement plan for parts of supplier, if applicable;
- Assurance of traceability, lot control and that only those parts, materials and processes authorized by supplier PMPCB are used in manufacture;
- Identification and control of age and cycle limited parts and materials;
- Implementation of a non-conform parts control program;
- Participation in program design reviews;
- Development of PMP milestones and task schedules;
- Reporting and delivery of PMP Data Items;
- Submission of proposed PMP lists (defined below) to supplier´s PMPCB approval;
- Nonconformance reporting and control.

6.3.4 DECLARED LISTS

Note: All PMP used in INPE´s space program flight hardware requires INPE´s PMPCB approval

6.3.4.1 GENERAL

The supplier, including its sub-suppliers, shall submit the following lists PMP proposed:

a) Electrical, electronic and electromechanical parts list;

b) Mechanical parts list;

c) List of materials including, for example: chemical, metallic, composites, optical, and soldering;

d) List of processes including: all operations, treatments or procedures used as a step in the manufacture of items;

e) List of connection technologies as for example soldering, crimping, wire-wrapping, surface mounted devices, printed circuit boards;

f) List of sensitive radiation parts and materials;

g) List of critical PMP.

The supplier shall submit, after initial approval by INPE´s PMPCB, all additions and deletions to the approved lists, on a monthly basis.

6.3.4.2 DECLARED MATERIAL LIST - DML

a. DML shall be broken down into clear categories to facilitate locating each item in the documentation.

b. The DML format shall include the following information:

- material specification,
- Reference code of the material. The reference code is kept the same throughout the duration of the project,
- material designation (commercial identification).
- manufacturer(s); procurement specifications or documents,

- summary of processing parameters (finish, temper condition, mix ratio, curing, etc...),
- use and location,
- drawing number and change letter
- test data as for example: outgassing, stress corrosion cracking, and corrosion;
- approval status (with reference to the approval authority, to test report and similar previous applications).
- Size or weight of applied material.

c. Use of codes: any coding or acronyms used within the list shall be defined within the document.

6.3.4.3 DECLARED MECHANICAL PARTS LIST - DMPL

a. DMPL shall be broken down into clear categories to facilitate locating each item in the documentation.

b. The DMPL format shall include the following information:

- Reference code of the mechanical part (as the reference of the part in the DMPL); the reference code is kept the same throughout the duration of the project,
- Part designation (commercial identification),
- Type of Parts,
- Manufacturer; procurement specifications or documents,
- Summary of functions and characteristics
- Use and location,
- Drawing number and change letter
- Approval status (with reference to the approval authority, to test report and similar previous applications).
- Environment characteristics: radiation (outside in sunlight, outside in shadow, inside spacecraft), pressure and temperature range.

c. Use of codes: any coding or acronyms used within the list shall be defined within the document

6.3.4.4 DECLARED PROCESS LIST - DPL

a. DPL shall be broken down into clear categories to facilitate locating each item in the documentation

b. The DPL format shall include the following information:

- -Reference code for process (as the reference of the Process in the DPL): the reference code is the same throughout the duration of the project,
- Process identification,
- Process specification,
- Process description (with associated materials designation if possible),
- Use and location,
- Process Supplier,

- ❖ Associated DML item numbers,
- ❖ Approval status (with reference to the approval authority, to the test report and similar previous applications).

c. Use of codes: Any coding or acronyms used within the list shall be defined within the document

6.3.4.5 DECLARED COMPONENT LIST (DCL)

The Declared Component List (DCL) is used to gather information about EEE parts required to assembly each project equipment.

The DCL shall be created in accordance with "SESEQ-Q-PRC-00151 - Electrical, Electronic and Electromechanical Parts Requirements Control of the EEE Group" and submitted to INPE/EEE to approval.

6.3.5 TECHNICAL REQUIREMENTS

6.3.5.1 ELECTRICAL, ELECTRONIC AND ELECTROMECHANICAL REQUIREMENTS

The Technical Requirements for Electrical, Electronic and Electromechanical Parts shall be in accordance with "SESEQ-Q-PRC-00151 - Electrical, Electronic and Electromechanical Parts Requirements Control of the EEE Group".

6.3.5.2 SELECTION

The electrical, electronic and electromechanical parts shall be selected in accordance with "SESEQ-Q-PRC-00151 - Electrical, Electronic and Electromechanical Parts Requirements Control of the EEE Group".

6.3.5.3 AVAILABILITY PARTS

The supplier shall guarantee that any parts selected for the space program are available for the project lifetime.

6.3.5.4 PARTS FROM STOCK

The supplier shall consider that the storage term is established as 7 (seven) years, plus more 3 (three) years with a relifing tests conducted according to ECSS-Q-ST-60-14C - Space product assurance - Relifing procedure – EEE components.

6.3.5.5 INCOMING INSPECTION OF PARTS

The incoming inspection procedure of EEE parts shall be defined in accordance with SESEQ-Q-PRC-00151 - Electrical, Electronic and Electromechanical Parts Requirements Control of the EEE Group.

6.3.5.6 MATERIALS

Materials shall be selected preferentially among those with space qualification or those having demonstrated a heritage of space use, formally validated.

Note: The document SESEQ-E-PRC-00124 - Mechanical Parts, Materials and Processes Requirements of the Product Engineering Group defines the requirements for space qualified materials.

6.3.5.7 METALLIC MATERIALS

All high strength alloys based on aluminum, magnesium, titanium, beryllium and stainless steel shall be considered potential candidate materials.

Note: The document SESEQ-E-PRC-00124 - Mechanical Parts, Materials and Processes Requirements of the Product Engineering Group defines the requirements for metallic materials.

6.3.5.8 NON-METALLIC MATERIALS

Non-Metallic Materials shall be chosen preferentially among those with space qualification or those having demonstrated a heritage of space use, formally validated. The document SESEQ-E-PRC-000124 - Mechanical Parts, Materials and Processes Requirements of the Product Engineering Group defines the requirements non-metallic materials.

The supplier shall propose an analysis for each material that does not comply with outgassing specification to prove its compatibility with the space program. The analysis shall include quantitative, geometric, thermal and spectral considerations and be approved by PEG before INPE´s PMPCB.

6.3.5.9 INCOMING INSPECTION OF MATERIALS

The incoming inspection procedure shall be defined at document SESEQ-E-PRC-00124 - Mechanical Parts, Materials and Processes Requirements of the Product Engineering Group.

6.3.5.10 LIMITED –LIFE

Each supplier shall ensure that all Materials, which have limited-life characteristics, have their manufacture date and shelf-life expiry date accurately identified and clearly marked on each lot/ batch. Materials, which have exceeded their shelf life, shall be re-validated only after the physical and chemical characteristics have been inspected and the parameters, subject to deterioration, have been evaluated for continued acceptability. The PEG shall evaluate the results and the acceptance before INPE´s PMPCB.

6.3.5.11 HEALTH AND SAFETY

Material Safety Data Sheet or equivalent shall be available for safety critical material. Precautionary provisions shall be identified as appropriate. Safety critical material shall be included in critical material list.

6.3.5.12 NON-ELECTRONIC PARTS

The supplier shall propose and perform an analysis and a testing program for all the mechanisms and pyrotechnics in order to evaluate their suitability for INPE´s space program application. The mechanical parts approval programs and test results shall be approved by PEG before INPE´s PMPCB. The electro mechanical and pyrotechnic mechanism approval programs and test results shall be approved by EEE before INPE´s PMPCB. This analysis, approval program and results shall be approved by INPE´s PMPCB.

6.3.6 PROCESSES

6.3.6.1 GENERAL

The supplier shall maintain a formal procedure for approval all processes proposed for the space program in accordance with requirements described herein. Critical processes (see 9.8) approval programs and test results shall be approved by PEG before INPE´s PMPCB.

6.3.6.2 DOCUMENTATION

The suppliers shall manage the documentation for procedures, work instructions, registers for validation and qualification of MPMP, according to the Document Requirement Descriptions (DRD) for validation and qualification of MPMP.

6.3.6.3 QUALIFICATION

All processes for the space program application shall have prior demonstration in flight hardware or by an evaluation/qualification program.

Note: The Document Requirement Description (DRD) is a guide to the qualification process.

The supplier, approach to qualification process shall be defined in PMP Plan.

The results of the qualification plan for each process shall be available to INPE´s PMPBC review.

Critical process that has prior demonstration in flight hardware shall have evidences to demonstrate this experience and be available to INPE´s PMPCB review.

6.3.6.4 PERSONNEL

The supplier shall verify and assure the proficiency, capability and adequacy of personnel and equipment of all processes used in the space program, in particular: metallurgical, chemical, material cleaning, potting, welding, soldering, coating, plating and other processes where quality cannot be assured by inspections of end articles alone.

6.3.6.5 CONFORMANCE OF PROCESSES UTILIZATION

In order to guarantee the conformance of each process the supplier shall assure that:

- The processes applications comply with processes specifications;
- The Mandatory Inspection Points in process are performed;
- Samples made from the same materials and by the same process as those used in the manufacture of the assemblies are submitted to conformance tests. After testing those samples are identified and retained.

6.3.6.6 SPECIAL PROCESSES

Note: Special processes refer to process where the quality cannot be completely ensured by inspection of the end article only, as for example, surface treatment, soldering, electric and electronic soldering, and gluing.

Quality control shall be carried out via processes operation procedure, equipments and instruments, work medium, and environmental condition.

Special processes shall establish special quality control measurement. Conditions of personnel, equipments, environment and parameters of other processes shall be strictly controlled according to process documents and corresponding standards.

Special process shall have Mandatory Inspection Points conducted by Quality Assurance and Product Engineering Groups previously defined.

6.3.6.7 CONNECTION TECHNOLOGIES

Connection technologies are particular processes for electronic assembly and packaging and shall be considered as special process.

6.3.6.8 HANDLING AND STORAGE

Supplier shall be established and implement a procedure for handling and storage of sensitive parts in order to prevent possible degradation.

The PMP shall be handled and stored in a controlled environment regarding its cleanness, clean room Class 8 [DA01] facility.

The temperature and humidity shall be controlled in the range of 22± 3°C and 55±10%, respectively.

The ESD controls shall be implemented to handle and store the sensitive parts.

6.3.7 SENSITIVE RADIATION PARTS AND MATERIALS

The supplier shall identify radiation sensitive parts and materials and provide investigations to assure that they are able to withstand radiation effects during mission life. The supplier responsible for the design of the piece of hardware shall demonstrate the compliance of components selection with the radiation constraints of the project.

The radiation tolerance specified for each space program shall be defined in the Satellite Environmental Specification (EVS).

Note: The document SESEQ-Q-PRC-000149 – Radiation Requirements Control for Satellite System of the Radiation Group defines the radiation requirements.

The radiation analysis document for each sensitive part/material shall be approved by INPE´s PMPCB. All radiation analysis document shall be evaluated for Radiation Group before submitted to INPE´s PMPCB for approval.

6.3.8 CRITICAL PARTS, MATERIALS AND PROCESSES

The supplier shall identify and propose control procedures for each critical PMP.

PMP shall be considered critical if meet any of the following criteria:

- The part or material is used in a single point failure application;
- The use of a part or material, which has a high technical risk; i.e., stringent performance requirements relatives to state-of-the-art techniques for the item;
- The part or material used is stressed in excess of recommended derating criteria;
- The part or material used is a long lead time procurement item;
- A process which in case of failure can adversely affect the performance of a major part or function of the spacecraft;
- The PMP is new or does not have sufficient history to provide confidence in its reliability.

6.3.9 PARTS AND MATERIALS APPROVAL REQUEST (PAR/MAR)

The supplier shall submit to INPE´s PMPCB an approval request parts or materials that do not meet the requirements defined at the documents:

- SESEQ-Q-PRC-00151 - Electrical, Electronic and Electromechanical Parts Requirements Control of the EEE Group;
- SESEQ-X-PRC-00124 - Mechanical Parts, Materials and Processes Requirements of the Product Engineering Group;
- SESEQ-Q-PRC-000149 – Radiation Requirements Control for Satellite System of the Radiation Group.

The procurement shall follow the requirements established in the PAR/MAR.

Note: The data required for this request is defined at the requirements documents above. When the parts or materials have already PAR/MAR approved it is not necessary to submit a PAR/MART.

Suppliers shall propose an evaluation/qualification program and submit to INPE´s PMPCB. The final approval of a PAR/MAR shall be given after completion and review of test program.

The evaluation/qualification program shall cover, as applicable, the following elements:

i) Design and Applications Assessment;

ii) Construction Analysis;

iii) Manufacturers Assessment;

iv) Electrical Stress Test (according to SESEQ-Q-PRC-00151 - Electrical, Electronic and Electromechanical Parts Requirements Control of the EEE Group);

v) Mechanical Stress Test,

vi) Environmental Stress Test;

vii) Operation Life Test;

viii) Radiation Test (if necessary);

ix) Additional Precap /Screening or Incoming Inspection effort (according to SESEQ-Q-PRC-00151 - Electrical, Electronic and Electromechanical Parts Requirements Control of the EEE Group).

6.3.10 COMMENTS

a. The supplier shall establish clear acceptance/rejection criteria for incoming inspection specified in 9.6.2.2, 9.6.2.3 and conformance inspections defined in 9.6.4.5. Any PMP not meeting the acceptance criteria shall be dispositioned as major nonconformance. All PMP quality or application problems identified during test at manufacturers or equipment test shall be classified as major nonconformance. The respective failure analysis of PMP problems shall be submitted to INPE´s PMPCB.

b. The INPE´s PMPCB shall review and evaluate the alerts and other available information relating to defective PMP to ensure that they are not selected for use in INPE´s space program.

c. The government member or designated representative shall have the right to audit the supplier in their plants in order to inspect the PMP Plan application. The presence of INPE is required for government member or designated representative visiting of supplier plant. All the space program PMP relevant documents shall be available for government member or designated representative review at least at supplier plant. The government member or designated representative reserves the right to request for review any PMP supplier documents or test data described in this chapter.

d. The requirements of this chapter shall not relieve the supplier of the responsibility for complying with all other requirements defined in the applicable specifications and contracts.

e. The supplier shall describe the methods and procedures that they will adopt to ensure that sub-supplier comply with all requirements defined herein.

6.3.11 DELIVERABLE PMP DATA

6.3.11.1 DATA TO BE SUBMITTED

The supplier shall submit:

a. PMP Plan;
b. Declared lists;
c. PMP Nonconformance;
d. Part approval request and test results;
e. Material approval requests and tests results;
f. Analysis/approval program and test results of non-electronic components;
g. Approval program and test results of special processes;
h. Approval program and test results of critical processes;
i. Sensitive radiation parts and materials analysis and test results, if applicable;
j. PMP failure analysis;
k. Analysis of material out gassing compatibility.

6.3.11.2 DATA TO BE MAINTAINED AVAILABLE

The supplier shall maintain available, as a minimum:

a. Part incoming inspection results;
b. Material incoming inspection results;
c. Conformance process results;
d. Approval program and test results of processes;
e. PMP plan of all subcontractors;
f. Coordinated procurement plan;
g. Reports of audits and surveys in subcontractors.

7 QUALITY ASSURANCE FOR EEE PARTS

TBD-4

7.1 RADIATION

TBD-5

8 SOFTWARE PRODUCT ASSURANCE

8.1 APPLICABLE DEFINITIONS

When identifying, developing, verifying, and maintaining software, the developer shall apply the following definitions:

a. Software is defined as computer programs, procedures, scripts, rules, and associated documentation pertaining to the development and operation of a computer system. Software includes commercial-off-the-shelf (COTS) software, government-off-the-shelf (GOTS) software, modified-off-the-shelf (MOTS) software, custom software, reused software, heritage software, auto-generated code, and code executed on microprocessors.
b. Mission-Critical Software - Software that can cause, contribute to, or mitigate the loss of capabilities that are essential to the primary mission objectives. The software reliability assessment and analysis is focused on failure modes specific to post-separation mission phases.
c. Safety-Critical Software - Software that can cause, contribute to, or mitigate human safety hazards or damage to facilities. The software safety assessment and analysis is focused on hazards specific to Integration and Test, launch, and up through spacecraft separation from the launch vehicle.

8.2 SOFTWARE ACRONYMS E ABBREVIATIONS

AD – Applicable Document

AD – Architecture Design

AD – Architecture Design Document

COTS – commercial-off-the-shelf

CPU – Central Processing Unit

DD – Design Definition

DD – Design Definition Document

GOTS – government-off-the-shelf

ICD – Interface Control Document

MOTS – modified-off-the-shelf OM – Operation & Maintenance

PHD – Product History Document

RID – Review Item Discrepancy

SCM – Software Configuration Management

SCR – Software Change Request

SGE – Software General Requirements

SMR – Software Modification Report

SPM – Software Project Management

SPMP – Software Project Management Plan

SPR – Software Problem Report

SR – Software Requirements

SQAP – Software Quality Assurance Plan

SRN – Software Release Note

SRB – Software Review Board

STD – Software Transfer Document

SUM – Software User Manual

SVV – Software Verification & Validation

SwPA – Software Product Assurance

TS – Transfer of the Software to Operations

UR – User Requirements

UR – User Requirements Document

V&V – Verification and Validation

WBS – Work Breakdown Structure

8.3 SOFTWARE GENERAL REQUIREMENTS (SGE)

SGE01

All software products shall be classified according to their criticality, as defined in [AD-7, ECSS-Q-ST-80C Rev.1], requirement 5.4.4.

SGE02

All software projects shall have a life cycle approach which includes the basic phases:

- UR phase – Definition of the user requirements
- SR phase – Definition of the software requirements
- AD phase – Definition of the architectural design
- DD phase – Detailed Design and production of the code
- TS phase – Transfer of the Software to operations
- OM phase – Operations and Maintenance

In small projects, the SR and AD phases may be combined into an SR/AD phase.

SGE03

The SQAP (Software Quality Assurance Plan) shall describe, in detail, the quality assurance activities to be carried out in the phases.

SGE04

For incremental delivery, each user requirement shall include a measure of priority so that the developer can decide the production schedule.

SGE05

Each user requirement shall include an identifier.

SGE06

Essential user requirements shall be marked (identified) as such.

SGE07

Each requirement shall be verifiable.

SGE08

The outputs of a phase shall be formally reviewed in the end of this specific phase Review.

SGE09

User requirements identified as not-applicable to a phase shall be clearly flagged in this specific phase.

SGE10

The phase activities shall be carried out according to the plans defined in the precedent (prior) phase.

SGE11

References that trace software requirements back to the URD (User Requirement Document) shall accompany each software requirement.

8.4 SOFTWARE PROJECT MANAGEMENT REQUIREMENTS (SPM)

SPM01

All software project management activities shall be documented in the Software Project Management Plan (SPMP).

SPM02

The Software Requirements Phase section of the SPMP shall be produced (SPMP/SR phase), by the end of the User Requirements review.

SPM03

The SPMP, in the SR phase, shall outline a plan for the whole project.

SPM04

An estimate of the effort involved in the Software Requirements phase shall be included in the SPMP/SR.

SPM05

The Architectural Design phase section of the SPMP shall be produced (SPMP/AD), during the Software Requirements phase.

SPM06

An estimate of the total project cost shall be included in the SPMP/AD.

SPM07

An estimate of the effort involved in the Architectural Design phase shall be included in the SPMP/AD.

SPM08

The Detailed Design phase section of the SPMP shall be produced (SPMP/DD), during the Architectural Design phase.

SPM09

An estimate of the total project cost shall be included in the SPMP/DD.

SPM10

The SPMP/DD shall contain a WBS (Work Breakdown Structure) that is directly related to the decomposition of the software into components (software components).

SPM11

The SPMP/DD shall contain a planning network showing relationships of coding, coding documentation, integration and testing activities.

SPM12

The V&V phase section of the SPMP shall be produced (SPMP/TS) during the Detailed Design phase.

8.5 SOFTWARE CONFIGURATION MANAGEMENT REQUIREMENTS (SCM)

SCM01

The configuration management procedures shall establish the secret level (sensitive or strategic technology level) of the software items, methods for identifying, storing and changing software items through development, integration and transfer.

SCM02

All software items shall be subjected to configuration management procedures as configuration items, including components, documentation, source code, object or relocatable code, executable code, files, tools, test software and data.

SCM03

A common set of configuration management procedures shall be used.

SCM04

Every configuration item shall have a unique identifier that distinguishes it from other items, including:

(a) A number or a name related to the purpose of the configuration item;
(b) An indication of the type of processing the configuration item is intended for (e.g. filetype information); and
(c) A version number.

SCM05

The configuration identification method shall be capable of accommodating new configuration items, without requiring the modification of the identifiers of any existing configuration items.

SCM06

As part of the configuration identification method, a software module shall have a standard header that includes:

(a) configuration item identifier (name, type, version);
(b) original author;
(c) creation date; and
(d) change history (version/ date/ author/ description).

SCM07

All documentation and storage media shall be clearly labelled in a standard format, with:

(a) project name
(b) configuration item identifier (name, type, version);
(c) date; and
(d) content description.

SCM08

The supplier shall ensure security and control of the software, implementing libraries for storing all the deliverable components (e.g. documentation, source and executable code, test files, command procedures), at a minimum:

(a) A Development (or Dynamic) library;
(b) A Master (or Controlled) library; and
(c) A Static (or Archive) library.

SCM09

Static libraries shall not be modified.

SCM10

Up-to-date security copies of master and static libraries shall always be available.

SCM11

Procedures for the regular backup of development libraries shall be established.

SCM12

The change procedure described shall be observed when changes are needed to a delivered document.

SCM13

The supplier shall provide a procedure for handling software problems and change proposals, to be submitted to the main contractor's SwPA approval.

SCM14

The status of all configuration items shall be recorded.

SCM15

To perform software status accounting, each software project shall record the date and version/issue of each (a) baseline; (b) RID; (c) SPR, SCR and SMR; (d) Configuration Item.

SCM16

As a minimum, the SRN shall record the faults that have been repaired and the new requirements that have been incorporated.

SCM17

For each release, documentation and code shall be consistent.

SCM18

Old releases shall be retained, for reference.

SCM19

Modified software shall be retested (unit test and regression test) before release.

SCM20

All software configuration management activities shall be documented in the Software Configuration Management Plan (SCMP).

SCM21

Configuration management procedures shall be in place before the production of software (code and documentation) starts.

SCM22

The Software Configuration Management Plan (SCMP) shall cover the configuration management procedures for documentation, and any (test, case, etc.) tools outputs or prototype code, to be produced in each phase.

SCM23

The SCMP/TS shall cover the procedures for the configuration management of the deliverables in the operational environment.

8.6 SOFTWARE VERIFICATION & VALIDATION REQUIREMENTS (SVV)

SVV01

Each input and output to a phase shall be traceable to at least one output of that phase (forwards traceability).

SVV02

Each event identification shall include information about every function that originated it, including functions called by other functions.

SVV03

Functional and physical audits shall be performed before the release of the software.

SVV04

All software verification and validation activities shall be documented in the Software Verification and Validation Plan (SVVP).

SVV05

The SVVP shall ensure that the verification activities are appropriate for the degree of criticality of the software.

SVV06

The SVVP shall ensure that the verification activities meet the verification and acceptance testing requirements (stated in the SRD).

SVV07

The SVVP shall ensure that the verification activities verify that the product will meet the quality, reliability, maintainability and safety requirements.

SVV08

The SVVP shall ensure that the verification activities are sufficient to assure the quality requirements of the product.

SVV09

The SVVP/SR shall define how to trace user requirements to software requirements, so that each software requirement can be justified.

SVV10

The developer shall construct an acceptance test plan in the UR phase and document it in the SVVP.

SVV11

The SVVP/AD shall define how to trace software requirements to components, so that each software component can be justified.

SVV12

The developer shall construct a system test plan in the SR phase and document it in the SVVP.

SVV13

The SVVP/Architectural Design shall define the review and traceability procedures.

SVV14

The Detailed Design Document and code shall be evaluated according to the SVVP/AD review and traceability procedures.

SVV15

The developer shall construct an integration test plan in the AD phase and document it in the SVVP.

SVV16

The developer shall construct a unit test plan in the DD phase and document it in the SVVP.

SVV17

The unit, integration, system and acceptance test designs shall be described in the SVVP.

SVV18

The unit integration, system and acceptance test cases, procedures and report shall be described in the SVVP.

8.7 SOFTWARE QUALITY ASSURANCE REQUIREMENTS (SQA)

SQA1

An SQAP shall be produced by each contractor developing software.

SQA2

All software quality assurance activities shall be documented in the Software Quality Assurance Plan (SQAP).

SQA3

The SQAP/SR shall outline the quality assurance plan for the rest of the project.

SQA4

The SQAP/TR shall cover in detail all the quality assurance activities to be carried out from the start the TR phase until final acceptance in the OM phase.

8.8 SOFTWARE USER REQUIREMENTS (UR)

UR01

The source user of each user requirement shall be stated.

UR02

An output of the UR phase shall be the User Requirements Document (URD).

UR03

The URD shall always be produced before a software development is started.

UR04

The URD shall provide a general description of what the user expects the software to do.

UR05

The URD shall have all known user requirements.

UR06

The URD shall describe the operations the user intends to perform with the software system.

UR07

The URD shall define all the constraints that the user intends to impose upon any solution.

UR08

The URD shall describe the external interfaces to the software system or reference them in ICDs that exist or are to be written.

8.9 SOFTWARE REQUIREMENTS (SR)

SR01

The developer shall construct an implementation-independent model of what is needed by the user.

SR02

A recognized method for software requirements analysis shall be adopted and applied consistently in the SR phase.

SR03

An output of the SR phase shall be the Software Requirements Document (SRD).

SR04

The SRD shall be complete.

SR05

The SRD shall cover all the requirements stated in the URD.

SR06

A table (matrix) showing how user requirements correspond to software requirements shall be placed in the SRD.

SR07

The SRD shall not include implementation details or terminology, unless it has to be present as a constraint.

SR08

Descriptions of functions shall state only what the software is to do.

SR09

The SRD shall not specify hardware or equipment, unless it is a constraint placed by the user.

8.10 SOFTWARE ARCHITECTURE DESIGN REQUIREMENTS (AD)

AD01

A method for software design shall be adopted and applied consistently in the AD phase.

AD02

The developer shall construct a model describing the design of the software using implementation terminology.

AD03

Only the selected design approach shall be reflected in the ADD.

AD04

For each component the following information shall be detailed in the ADD: data input, functions to be performed and data output.

AD05

Data structures that interface components shall be defined in the ADD.

AD06

Data structure definitions shall include the:

- description of each element (e.g. name, type, dimension)
- relationships between the elements (i.e. the structure);
- range of possible values of each element;
- initial values of each element.

AD07

The control flow between the components shall be defined in the ADD.

AD08

The computer resources (e.g. CPU speed, memory, storage, system software) needed in the development environment and the operational environment shall be estimated in the AD phase and defined in the ADD.

AD09

The outputs of software architectural design activities shall be reviewed in the SR/AD phase review.

AD10

The ADD shall define the major components of the software and the interfaces between them.

AD11

The ADD shall define or reference all external interfaces.

AD12

The ADD shall be complete, covering all the software requirements described in the SRD.

AD13

A table (matrix) cross-referencing software requirements to parts of the architectural design shall be placed in the ADD.

8.11 SOFTWARE DESIGN DEFINITION REQUIREMENTS (DD)

DD01

DD phase activities shall be carried out according to the plans defined in the AD phase.

NOTE: DD phase plans are contained in the plans made in the UR phase and updated, as appropriate during the project.

DD02

The detailed design and production of software shall be based on the following three principles: (a) top-down decomposition; (b) structured programming; (c) concurrent production and documentation.

DD03

The integration process shall be controlled by the software configuration management procedures defined in the SCMP.

DD04

Before a module can be accepted, every statement in a module shall be executed successfully at least once.

DD05

Acceptance shall be performed by the project manager after unit testing and by the customer at the end of the phase.

DD06

Software projects shall:

a. set a statement testing target (e.g. 80% coverage)
b. review every statement not covered in testing.

NOTE: Software tools are available for measuring test coverage. They should be used whenever possible.

DD07

Integration testing shall check that all the data exchanged across an interface agrees with the data structure specifications in the ADD.

DD08

Integration testing shall confirm that the control flows defined in the ADD have been implemented.

DD09

System testing shall verify compliance with system objectives, as stated in the SRD.

DD10

When the design of a major component is finished, a critical design review shall be convened to certify its readiness for implementation.

DD11

After production, the DD Review (DD/R) shall consider the results of the verification activities to decide whether to transfer the software.

DD12

All deliverable code shall be identified in a configuration item list.

DD13

The DDD shall be an output of the DD phase.

DD14

The DDD shall account for all the software requirements in the SRD.

DD15

The DDD shall contain a traceability matrix cross-referencing software requirements to the detailed design components.

DD16

A Software User Manual (SUM) shall be an output of the DD phase.

8.12 TRANSFER OF THE SOFTWARE TO OPERATIONS

TS01

Representatives of users and operations personnel shall participate in acceptance tests.

TS02

The Software Review Board (SRB) shall review the software's performance in the acceptance tests and recommend, to the initiator, whether the software can be provisionally accepted or not.

TS03

TR phase activities shall be carried out according to the plans defined in the DD phase.

Note: TR phase plans are established in the UR phase and updated as appropriate.

TS04

The capability of building the system from the components that are directly modifiable by the maintenance team shall be established.

TS05

Acceptance tests necessary for provisional acceptance shall be the indicated in the SVVP.

TS06

The statement of provisional acceptance shall be produced by the initiator, on behalf of the users, and sent to the developer.

TS07

The provisionally accepted software system shall consist of the outputs of all previous phases and modifications found necessary in the TR phase.

TS08

An output of the TS phase shall be the STD.

TS09

The STD shall be handed over from the developer to the maintenance organization at provisional acceptance.

TS10

The STD shall contain the summary of the acceptance test reports, and all documentation about software changes performed during the TS phase.

8.13 SOFTWARE OPERATION & MAINTENANCE REQUIREMENTS (OM)

OM01

Until final acceptance, OM phase activities that involve the developer shall be carried out according to the plans defined in the SPMP/TR.

OM02

All the acceptance tests shall have been successfully completed before the software final acceptance.

OM03

Even when no contractor is involved, there shall be a final acceptance milestone to arrange the formal hand-over from software development to maintenance.

OM04

A maintenance organization shall be designated for every software product in operational use.

OM05

Procedures for software modification shall be defined.

OM06

Consistency between code and documentation shall be maintained.

OM07

Resources shall be assigned to a product's maintenance until it is retired.

OM08

The SRB shall evaluate and propose the authorization for all modifications to the software.

OM09

The statement of final acceptance shall be produced by the initiator, on behalf of the users, and sent to the developer.

OM10

The PHD shall be delivered to the initiator after final acceptance.

9 CONFIGURATION MANAGEMENT REQUIREMENTS

9.1 MANAGEMENT AND PLANNING

9.1.1 CONFIGURATION MANAGEMENT PLAN

Each supplier shall provide for customer's approval a configuration management plan in conformance with Annex A of [AD-16].

9.1.2 INFORMATION SECURITY

Information shall only be classified when imposed by program/project requirements or to protect company/organizational interests.

9.1.3 CONFIGURATION MANAGEMENT INTERFACES

a. Configuration management processes shall interface with project management and planning, taking into schedule organization for the definition and phasing of CM activities.
b. Configuration management processes shall interface with engineering and product assurance for agreeing the technical information for which CM process controls.
c. Configuration management process shall interface with information/documentation management for defining rules for documentation identification and processing, control and distribution.

9.2 IMPLEMENTATION OF CONFIGURATION MANAGEMENT

9.2.1 CONFIGURATION ITEM SELECTION

a. The supplier shall identify in the product tree, the configuration item and their applicable specifications, and agree these with its customer.
b. The supplier shall prepare the list of configuration items it supplies and keep this under configuration control.
c. The configuration item list shall be provided at the PDR for customer approval.

9.2.2 CONFIGURATION BASELINE

a. The supplier shall agree with its customer which documentation shall constitute each configuration baseline.
b. The baseline documentation shall reflect the actual configuration of the product, at any given point of the product life cycle.

9.2.3 BASELINE ESTABLISHMENT

i. Baselines shall be established at the conclusion of each technical review as the starting point for configuration control as defined below:
    a. The starting point of configuration control for functional specification is at conclusion of the preliminary requirements review, establishing the mission objective baseline.
    b. The starting point of configuration control for system technical specifications (TS) is at conclusion of the system requirements review (SRR), establishing the functional configuration baseline,
    c. The starting point of configuration control for product technical specifications (TS) and ICDs is at conclusion of the preliminary design review (PDR), establishing the

development configuration baseline. This represents freezing of performance and design requirements and control of developmental models.

d. The starting point of configuration control of the product design for PFM/FM model manufacturing for qualification purposes is at the conclusion of the CDR, establishing the design baseline.
e. The starting point of configuration control of the product design for PFM/FM model manufacturing for qualification purposes is at the conclusion of the CDR, establishing the design baseline.
f. The starting point of configuration control of the qualified product design for serial production is at the conclusion of the PCV, or for prototype(s) at QR/AR, establishing the product configuration baseline.
g. The starting point of configuration control of the user manual is at conclusion of the qualification review (QR).
h. The starting point for issue and maintenance of the log book is at conclusion of the acceptance review (AR).

ii. The supplier shall maintain the configuration baselines throughout the program or project life cycle.

9.2.4 IDENTIFICATION MARKING

Any product item shall be identified to guarantee its traceability throughout the program or project life cycle.

9.2.5 CONFIGURATION CONTROL

9.2.5.1 Change procedure

a. A change procedure shall be established to describe the process for changing a configuration baseline.
b. Any change to a configuration item, in relation to an approved configuration baseline, shall be described, justified and classified by the requesting party, before submission for review and disposition.
c. Each actor shall establish a configuration control board to evaluate and approve any change to a configuration item relative to a configuration baseline.
d. Related changes of several product resulting from a common need for change shall be processes simultaneously.

9.2.5.2 Initiation of change

a. All change initiated by the customer shall use a change request template.
b. All changes initiated by the supplier shall use a change proposal template.

9.2.5.3 Change assessment

a. Both customer and supplier shall establish procedures for the analysis, review and disposition of proposed changes.
b. The change assessment shall cover all technical, programmatic and operational impacts on all affected products for which the actor is responsible.
c. Each project actor shall assess any request or proposal for a change to a configuration baseline, which é presented to him by his custom or supplier.

9.2.5.4 Change disposition

a. All changes shall be dispositioned by the configuration control board as wither:
   - ❖ Approved, defining the applicability of evolution and associated implementation modes,
   - ❖ Rejected, with a supporting rational or
   - ❖ Deferred until additional information is provided.

9.2.5.5 Departures from configuration baseline

a. The supplier shall request planned departures from requirements or design using a request for deviation.
b. The supplier shall request unplanned departures from requirements or design using a request for waiver.
c. The configuration control board shall process deviations and waivers from baselined requirements or design when customer requirements are affected.

9.2.5.6 Baseline and documentation update

a. Configuration baselines shall be updated in conformance with the disposition of approved changes and deviations.
b. Configuration-controlled documents shall be revised to incorporate approved changes.

9.2.5.7 Interface control

a. Each actor shall record the status of interface definition data.
b. Each actor shall ensure that all interface definition data is consistent with its product configuration.
c. The supplier shall identify and control the internal interfaces of its product and those interfaces for which he has received delegated authority.
d. Configuration management shall stablish, concurrently with the system engineering, the overall organization and procedures to process and manage changes to interfaces.
e. Each actor shall clearly identify in configuration definition documentation the data subject to interface management.

9.2.6 CONFIGURATION STATUS ACCOUNTING

All actors shall establish a configuration status accounting system to record, store the following configuration data:

a. Status of the configuration baselines
b. Design status of the configuration items
c. As-built status of accepted products
d. Status of configuration documentation and configuration data sets
e. Status of approval of changes and deviations and their status of implementation, the status of waivers
f. Status of actions derived from technical reviews and configuration verification reviewers.
g. Each supplier shall provide configuration status accounting reports.

9.2.7 AS-DESIGNED DATA LIST

a. The supplier shall provide a configuration item data list (CIDL) for each deliverable configuration item.

b. For each deliverable software configuration item, the supplier shall provide a software configuration file.
c. A CIDL shall be available for the first design review to determine the initial configuration baseline.
d. The complete CIDL for an individual configuration item, model or deliverable item shall be available at project reviews.
e. Changes implemented after delivery of the product shall be incorporated in the CIDL.
f. The updated CIDL shall be provided for log-book updating.

9.2.8 AS-BUILT DATA LIST

a. For each deliverable serial number of configuration item, the supplier shall provide and as-built configuration data list (ABCL).
b. The ABCL shall identify the “as manufactured” and “as tested” statuses applicable to parts composing a configuration item.
c. Using the CIDL as a reference, any difference between the ABCL and the CIDL shall be documented in the ABCL by reference to the applicable Non-conformance Report or Request for Waiver.

9.2.9 CONFIGURATION VERIFICATION

a. At SRR, the functional configuration definition shall be verified against mission objectives.
b. At PDR, the development configuration definition shall be verified against the applicable technical specifications.
c. At CDR, the design definition shall be verified against the relevant design documentation.
d. The supplier shall perform configuration verification by systematically comparing the “as-built” configuration of a configuration item with its “as designed” configuration.
e. Configuration in terms of functional and performance characteristics shall be verified at qualification review (QR) for prototype or proto-flight production.
f. Configuration in terms of physical and nominal performance characteristics shall be verified at AR for prototype or proto-flight production.

9.2.10 AUDIT OF THE CONFIGURATION MANAGEMENT SYSTEM

Each project actor shall conduct internal audits to verify the application of configuration management requirements internal to his organization.

Each project actor shall conduct external audits to verify the application of configuration management requirements by its lower ties suppliers

LISTA DE ITENS *TO BE DEFINED*		
ID	**DESCRIÇÃO**	**STATUS**
TBD-1	Alerts Process	Pending
TBD-2	DRD for Product Assurance Plan	Pending
TBD-3	Transportation requirements	Pending
TBD-4	EEE Requirements	Pending
TBD-5	Radiation Requirements	Pending
LISTA DE ITENS *TO BE CONFIRMED*		
ID	**DESCRIÇÃO**	**STATUS**
TBC-1	Dependability risk assessment and control	Pending
TBC-2	Dependability critical items	Pending
TBC-3	Design reviews	Pending
TBC-4	Dependability Engineering	Pending
TBC-5	Dependability Analyses	Pending
TBC-6	Severity Categories	Pending
TBC-7	Availability Analyses	Pending
TBC-9	Maintainability Analyses	Pending