DLR-RF-PS-005

Issue 1.1
Sept. 2008

PARTS PROCUREMENT & CONTROL PLAN FOR COMMERCIAL EEE-PARTS SUITABLE FOR SPACE APPLICATION IN THE <PROJECT> PROJECT

Deutsches Zentrum für Luft- und Raumfahrt

German Space Agency

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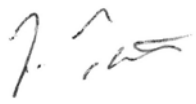
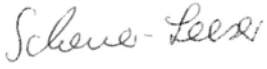
Prepared	**J. Tetzlaff / QP-NB** Standardization and EEE-Components DLR		Date: 19.09.2008
Approved	**M. Scheuer-Leeser / QP-L** Head of Product Assurance DLR		Date: 19.09.2008
Released	**C. Hohage / RD-J** Director Space Projects DLR		Date: 22.09.2008

Document Change Record

Issue/Rev	Date	Change Notice No.	Modified Pages or Paragraphs	Nature of Change
1.0	July 2002	-	Initial Issue	
1.1	Sept. 2008	-		Cover Sheet Added

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TESAT SPACECOM GmbH & Co.KG & Astrium GmbH

Prepared under
DLR Contract No. 50 PS 0010
Phase D, Work Package 2

CONTENTS

Note: this document contains a total number of 61 pages, as the PAD Sheet referenced under Appendix 1 is inserted as separate sheets not contained in this MS-WORD file.

1 SCOPE

1.1 Purpose

This Parts Procurement and Control Plan (PP&C Plan) defines the technical provisions, the associated managerial procedures, the engineering tasks and the quality assurance aspects which will be implemented for the co-ordinated parts procurement of commercial EEE parts in the <PROJECT> programme to guarantee a successful completion of the defined tasks.

1.2 Applicability

This plan is a response to the requirements given in the statement of work (SOW) reference [A1] and the Product Assurance Requirements [A2] for the <PROJECT> satellite / equipment as part of the TBD programme carried out by the DLR (Deutsches Zentrum für Luft- und Raumfahrt e.V.). It defines the tasks and deliverables required from the Co-ordinated Parts Procurement Agent (CPPA) for the procurement of suitable commercial EEE parts for the <PROJECT> flight hardware.

This plan is applicable for the engineering and procurement system of the {TBD company} acting as a co-ordinated parts procurement agent (CPPA) under contract of the prime contractor(s) or the DLR if and as applicable.

1.3 Objectives

In view of the fact that the maximum use of commercial components shall be pursued for the <PROJECT> programme, the main objective of this plan is to specify the methods applied and the approaches selected for the procurement of such parts within the project's budget constraints without, however, unduly jeopardising the quality and reliability requirements of the intended mission. Therefore, the use of standard space level EEE parts shall be considered only when a foreseen commercial part is not capable of meeting the mission requirements for whatever reason.

The CPPA activities will focus on the proper selection of suitable commercial part types by the various users, a co-ordination and standardisation of the individual parts lists and the procurement, testing and control of all parts in the most economical way, within the given time frame and with the required performance capabilities defined in the SOW.

These procurement tasks shall be carried out in a closed loop co-operation with the user companies or experimenters, the prime contractor(s) and/or the DLR.

1.4 Scenario Description

For reference purposes, the following scenario proposed by the DLR has been considered during the preparation of this plan:

Satellite Type	21 (in accordance with [R2])
Spacecraft Type	Scientific Observatory Spacecraft
Complexity	High
Budget	> 50 Mio €
Risk Policy	Priority high
Lifetime	> 5 years
Altitude	515 km
Launcher	Expendable Launch Vehicle (ELV)

2 APPLICABLE & REFERENCE DOCUMENTS

The documents listed in this section are applicable for the execution of the procurement activities in the <PROJECT> programme.

2.1 Applicable Documents

The documents listed in this section shall be applicable for the performance of the procurement activities. Deviations from the PA requirements shall be identified by the CPPA in a compliance matrix as a supplement to the draft Parts Procurement & Control Plan issued for the proposal.

Ref./ Hyperlink	Document Number	Document Title / Description
A1	DLR-RF-SOW-CPPA *)	<PROJECT> Programme Co-ordinated Parts Procurement Agent Statement of Work (CPPA-SOW)
A2	TBD	Product Assurance Requirements for the <PROJECT> Programme / Satellite
A3	TBD	Space Radiation Environment Specification for the <PROJECT> Programme Mission
A4	DLR-RF-PS-XXX *)	Assessment Procedure and Criteria for Determining Suitability of Commercial Components for Space Use
A5	DLR-RF-PS-YYY *)	Risk Analysis and Management Procedures (for use when Assessing Commercial Components for Space Use)

*) correct number TBD to fit the DLR CM rules and numbering system

CPPA documents

List of all in-house procedures of the CPPA which are used to control, monitor and report the activities in terms of

- Parts engineering
- Parts quality assurance
- Parts procurement or purchasing
- Parts storage
- Parts delivery to the users or experimenters
- Data and documentation management

[Note: when the below table has been filled out, this blue coloured text section shall be formatted as **hidden** text]

...	TBD	...
...	...	...
...	...	...

2.2 Reference Documents

R1	ECSS-Q-60A (19.04.1996)	Space Product Assurance: EEE Components
R2	DLR-RF-PS-001, Issue 4.0	Product Assurance & Safety Requirements for DLR-Space Projects
R3	IPC-SM-786	Recommended Procedures for Handling of Moisture Sensitive Plastic IC Packages

ECSS Documents

	ECSS-P-001	ECSS Glossary of Terms
	ECSS-Q-20-09A	Non-conformance Control System
	ECSS-Q-60-01A	European Preferred Parts List (EPPL) and its management ➔EEPL web site [https://escies.org/public/eppl]

ESA Documents:

	ESA PSS-01-301*)	Derating Requirements and Application for Electronic Components
	ESA PSS-01-605 *)	Capability Approval Program for hermetic thinfilm hybrid microcircuits
	ESA PSS-01-606 *)	The Capability Approval Program for hermetic thickfilm hybrids
	ESA PSS-01-608 *)	Generic Specification for hybrid microcircuits
	ESA PSS-01-720 *)	Determination of the susceptibility of silver-plated copper wire/cable to 'red plaque' corrosion
	ESA/SCCG	Specification system (Basic, Generic, Detail)
	ESA/SCC QPL	ESA/SCC Qualified Parts List

*) Note: the ESA PSS documents are in the conversion cycle to ECSS documents. Therefore, as soon as the equivalent documents are officially published they shall replace the listed PSS documents

US-MIL-Documents:

	MIL-STD-750	Military Standard, Test Methods for Semiconductor Devices
	MIL-STD-883	Military Standard, Test Methods and Procedures for Microelectronics
	MIL-PRF-19500	Military Specification, Semiconductor Devices, General Specification for
	MIL-PRF-38534	Military Specification, Hybrid Microcircuits, General Specification for

	MIL-PRF-38535	Military Specification, Integrated Circuits (Microcircuits) Manufacturing, General Specification for
	ER-MIL	Military Specification System (Established Reliability)
	MIL-QMLs	Military Qualified Manufacturer Lists
	MIL-QPLs	Military Qualified Parts Lists

Other documents:

...	TBD	If and as applicable
...	...	...

3 DEFINITIONS & ABBREVIATIONS & ACRONYMS

To assure a common understanding some definitions are presented below which are commonly used and important in a Co-ordinated Parts Procurement.

3.1 Definitions

Agent surcharge:

This cost corresponds to the amount charged by the CPPA for activities that are indirectly associated with parts procurement tasks such as writing specifications, negotiations with manufacturers, performing surveys and inspections, carrying out CAs, DPAs, FAs, etc.

Contractor

The company which has a contract with the DLR or the prime contractor(s) for a <PROJECT> equipment, also identified as a user or experimenter.

Consolidated Parts List

The consolidated parts procurement list is a compilation of the users parts lists (DCLs). The list is containing all information of the parts to be purchased centrally for the <PROJECT> programme such as technical data, costs overview and delivery status- see also (MPL)

Co-ordinated Parts Procurement Agent (CPPA)

The company who undertakes to procure EEE parts on behalf of the prime contractor(s) or DLR using a Co-ordinated Procurement System.

Co-ordinated Procurement

This is a procurement approach, where the agent receives the purchase orders for parts from various users, extracts and compiles the total need quantities per type and manufacturer along with any additionally necessary attrition including DPA, LAT or QCI and Radiation test samples and places the purchase orders at the various manufacturers. Upon receipt of the flight parts the ordered parts quantities will be shipped to the individual users. The recurring cost shall be paid by the users while the non-recurring cost will be paid by the customer(s).

Critical Items

Critical items are those parts being identified from user need which either require special effort to be procured until the user need date, i.e. long lead items (LLIs), or items which bear a risk from technical or application point of view.

Cut-off Date

The cut-off date is the date by which the users must have placed their purchase orders to the procurement agent. After the cut-off date, the procurement agent will place collective purchase orders to the suppliers of the components. The cut-off date is also called “closing date”.

For any order placed after the cut-off date, the user shall pay the recurring **and** the non-recurring cost, the agent’s surcharge and any additional cost incurred by this order. Further, the user shall be also liable for any shift in the program schedule caused by this delay.

Customer

The customer(s) for the <PROJECT> project, i.e. the prime contractor(s) or DLR, as applicable.

Declared Component List (DCL) of the Users

Each user will prepare a declared component list (DCL) which lists all EEE part types needed to manufacture the flight hardware for the foreseen space application in the <PROJECT> programme. Users may prepare different DCLs for various equipment.

European Vendor

A European company meeting the requirements of a vendor in Europe.

Frame Purchase Order:

A harmonised contract defining the duties, responsibilities and liabilities of each party and valid between the user or experimenter and the CPPA. This contract is imposed on all users participating in the Co-ordinated Parts Procurement for the <PROJECT> programme.

<PROJECT> Parts Co-ordination Board (PPCB)

The PPCB is understood as a consulting technical authority set up by the prime contractor(s) or DLR in order to combine user needs in terms of quantities and achieve a standardisation resulting in lower prices. PPCB also controls and harmonises all technical and procurement aspects.

Flight Part

A part which can be demonstrated as being suitable for use within the <PROJECT> project flight hardware and which meets the requirements of the applicable procurement specifications or documents.

Freeze Date

The freeze date is the date at which users must have confirmed their requirements for the parts. After the freeze date, the technical and commercial conditions for the components are fixed and quotations for the parts are sent to the users.

Master Procurement List (MPL)

The MPL is the compilation and integration of all user DCLs after consolidation and after the standardisation and type reduction exercise. It is the reference basis for all parts procurement activities to be carried out by the CPPA in terms of technical data, costs overview and delivery status

Non-recurring cost

All costs other than the recurring cost related to the parts procurement, including all fixed and corresponding lot related charges

Non-standard Components

All components not belonging to the standard parts categories and not listed on the <PROJECT> PPL if existing.

Part

The smallest subdivision of a system which cannot be further subdivided without destruction, i.e. resistors etc. It is used in the same sense as "component" or “device”.

Preferred Part

A part which is listed in the European Preferred Parts List (EPPL); however, a project PPL to be prepared for <PROJECT> - once established and in effect - may take precedence over the EPPL.

Prime Contractor

The company with total system responsibility to / for the <PROJECT> programme, i. e. the prime contractor or DLR (while a prime contractor is not yet selected).

Recurring cost

The direct cost of an EEE parts ordered calculated on unit price multiplied with the quantity of parts ordered (per user or per equipment as applicable).

Self-procured Part:

This term refers to ASICs or custom Hybrids and particularly to some components needed by a single user who is also responsible for the procurement. The assignment as a self-procured part shall be mutually agreed between the user, the CPPA and the prime contractor(s) and/or the DLR as applicable.

Special Part

A part which either is manufactured using special techniques or has to be specially designed for use on <PROJECT>. Examples of such parts are ASICs.

Screening Tests

Those tests, conducted on all parts from selected lots, which are designed to detect defective or failed parts and potential early or infant mortality failures so that they may be removed from the batch before the batch is released for use.

Standard Parts

All components which are listed in the <PROJECT> project PPL if and as established by the prime contractor(s) and previously agreed by the DLR.

If the preparation of a project PPL is not envisaged, standard parts shall be understood as those parts capable of meeting the project's mission requirements:

- Commercial parts which have successfully passed or are capable of passing a space application suitability assessment as defined in [A4]
- Standard space level parts listed in:
  - ESA/SCC QPL, QML
  - EPPL Part I
  - NASA Parts Selection List (NPSL)
  - MIL QPLs, QMLs
  - Other approved project parts lists with a similar application and procured to a quality level equivalent to or more stringent than required in this parts procurement and control plan.

Stock

Parts which are immediately available from stock for flight equipment.

User

A user is a recipient of EEE parts.

Vendor

A company which conducts all the manufacturing and test activities for a part type.

Vendor cost:

The sum of the recurring and non-recurring costs charged or invoiced by a parts manufacturer.

Vendor Surveillance

That series of activities, conducted by the contractor or procurement agent at the vendor's facility, which is designed to ensure that the schedule and the detail requirements of the procurement specification have been met.

3.2 Abbreviations & Acronyms

AI	Action item
AQL	Acceptance Quality Level
CA	Construction Analysis
CM	Configuration Management
CoC	Certificate of Conformance
CPPA	Centralised or Co-ordinated Parts Procurement Agent
DCL	Declared Component List (= user parts list)
DDD	Displacement Damage Degradation
DLR	Deutsches Zentrum für Luft- und Raumfahrtangelegenheiten
DPA	Destructive Physical Analysis
DRD	Document Requirements Description
DRL	Document Requirements List
ECSS	European Co-operation for Space Standardisation
EEE-parts	Electrical, Electronic & Electromechanical parts
ELV	Expendable Launch Vehicle
EMPL	Extract of the MPL filtered for a specific user
FA	Failure Analysis
FPO	Frame Purchase Order (between user / experimenter and CPPA)
LAT	Lot Acceptance Test
LLI	Long Lead Item
MPL	Master Procurement List
MRB	Material Review Board
NCR	Non-Conformance Report
NRB	Non-Conformance Review Board
PA	Product Assurance
PAD	Parts Approval Document
PCB	Parts Co-ordination Board
PPL	Preferred Parts List
QA	Quality Assurance
QCI	Quality Conformance Inspection
QML	Qualified Manufacturer Listing
QPL	Qualified Parts List
RFD/RFW	Request for Deviation/Waiver
RFQ	Request for Quotation
RVT	Radiation Verification Test
SEB	Single Event Burn-out
SEGR	Single Event Gate Rupture
SEL	Single Event Latch-up
SEP / SEE	Single Event Phenomena / Effects
SET	Single Event Transient
SEU	Single Event Upset
SOC	Statement of Compliance
SOW	Statement of Work
TBD	To Be Defined
TID	Total Ionising Dose

3.3 Hyperlinks

For easy reference of the applicable documents or reference documents defined in section 2, hyperlinks are introduced at many locations in the text in the following format

e.g. [A1], [R3] or [XXXX]

In the electronic version of this document these hyperlinks can be clicked with the left mouse button to directly jump to the relevant location or bookmark in the text. Therefore, they should not be deleted from the file.

4 PROCUREMENT SCHEME

In line with the SOW requirement a co-ordinated parts procurement approach shall be chosen for the <PROJECT> programme

The appropriate contractual relationship between the Customer (DLR), the user and the CPPA are given in the following section.

4.1 Co-ordinated Parts Procurement Scheme

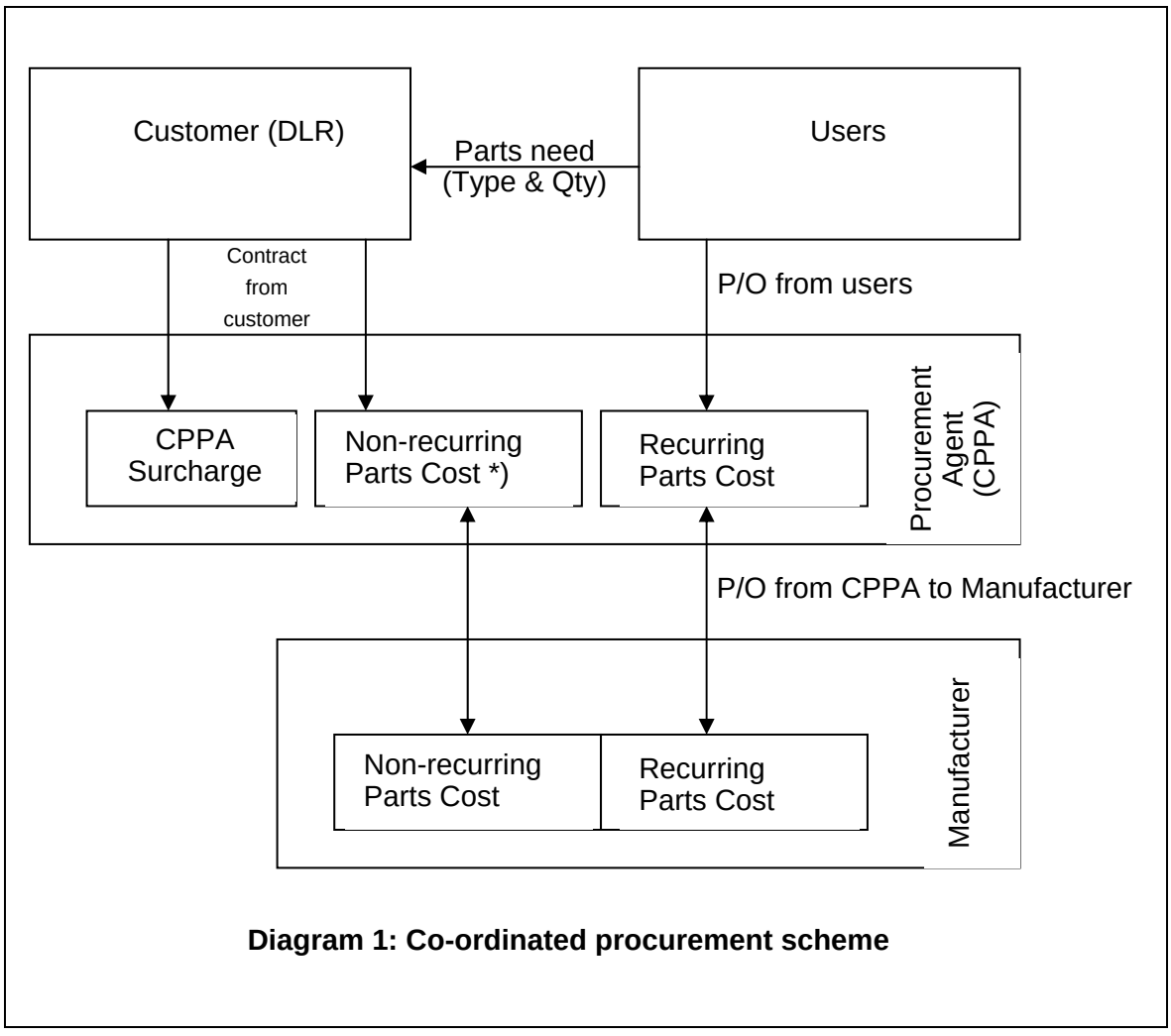

Diagram 1: Co-ordinated procurement scheme

Although the information about user need quantities and part types is also provided through the customer, a direct and contractual relationship exists between each individual user and the CPPA. In addition it is also the CPPA's duty to collect all user parts lists and to establish a consolidated project parts list (or Master Procurement List – MPL) after a type reduction exercise has been carried out with all users. As a result, the CPPA has to wait for the purchase order from the last user before he can issue a common purchase order to each manufacturer. Further, another difference from a centralised procurement is that the users are required to pay the Recurring cost directly to the CPPA, while the Non-recurring cost and the CPPA surcharge is paid by the customer.

*) Note: for DLR internal budget distribution reasons the Non-recurring cost will be split-up into a share for qualification activities and another share for project related cost).

4.2 The <PROJECT> CPPA Team

The basic management structure of the CPPA's project organisation is depicted in the following chart which indicates the CPPA's project manager as the key access point of information exchange between CPPA and the prime contractor(s) and/or the DLR as applicable.

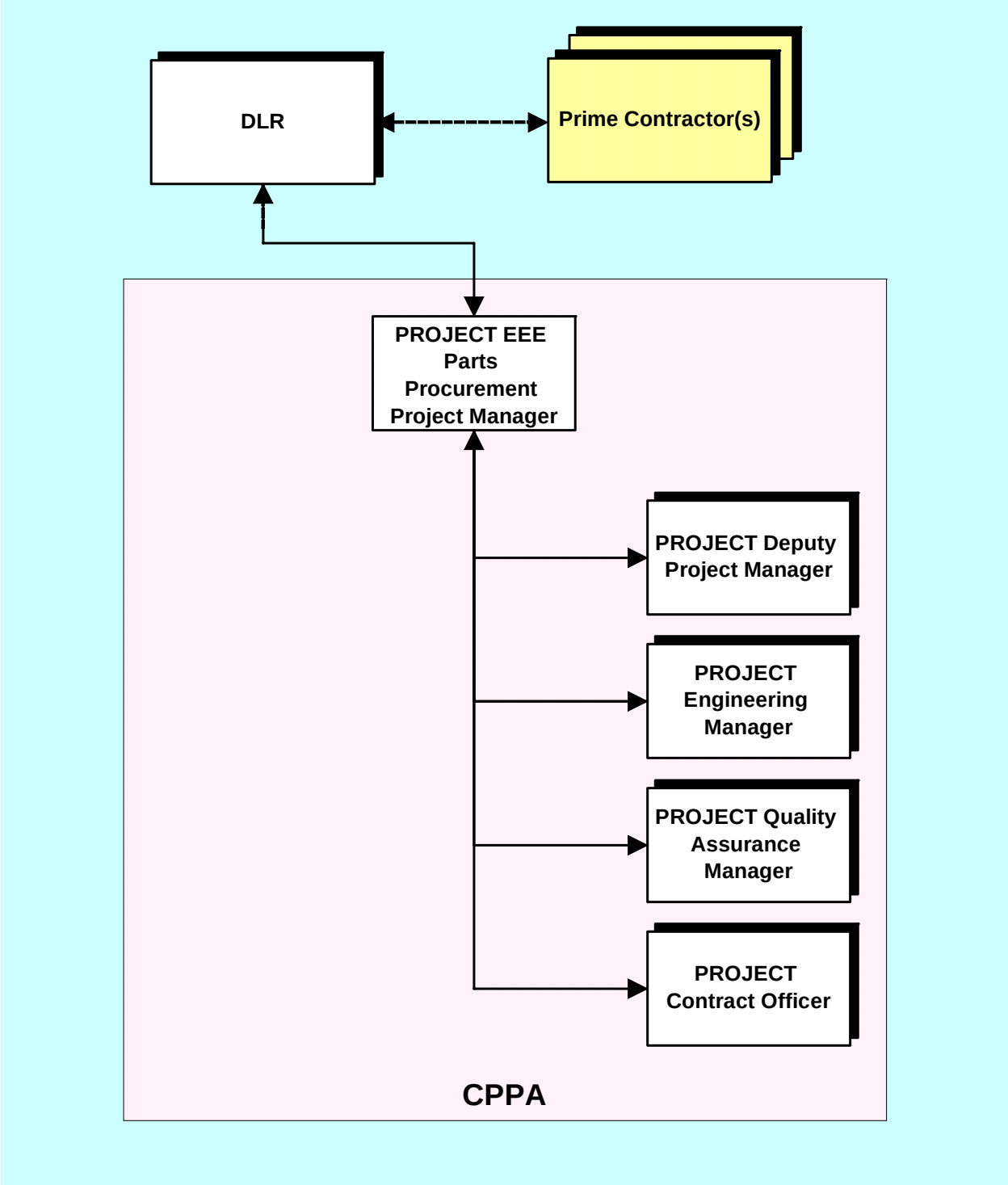

Chart 1: Management structure of the CPPA project team

4.3 Key Personnel

The proposed management structure is shown in Chart1.

The structure of the management team at CPPA includes the following persons:

- A project manager
- A deputy project manager
- An engineering manager
- A quality assurance manager
- A contract officer

The project manager shall act as the single point of contact for DLR, prime and users for all matters relating to the project. He will be supported by a deputy project manager during the initial phase of the project where a high level of effort will be required to set up the project.

It will depend, however, on the size, volume and foreseen duration of the <PROJECT> parts procurement programme whether CPPA will establish a dedicated and full-time acting project group or if the necessary activities will be shared with other tasks in the CPPA's in-house organisation. Accordingly, the engineering manager may also act as the deputy project manager.

4.4 Task Sharing

The block diagram given below shows the detailed CPPA tasks and interactions to manufacturers, users and DLR/Prime(s), as applicable.

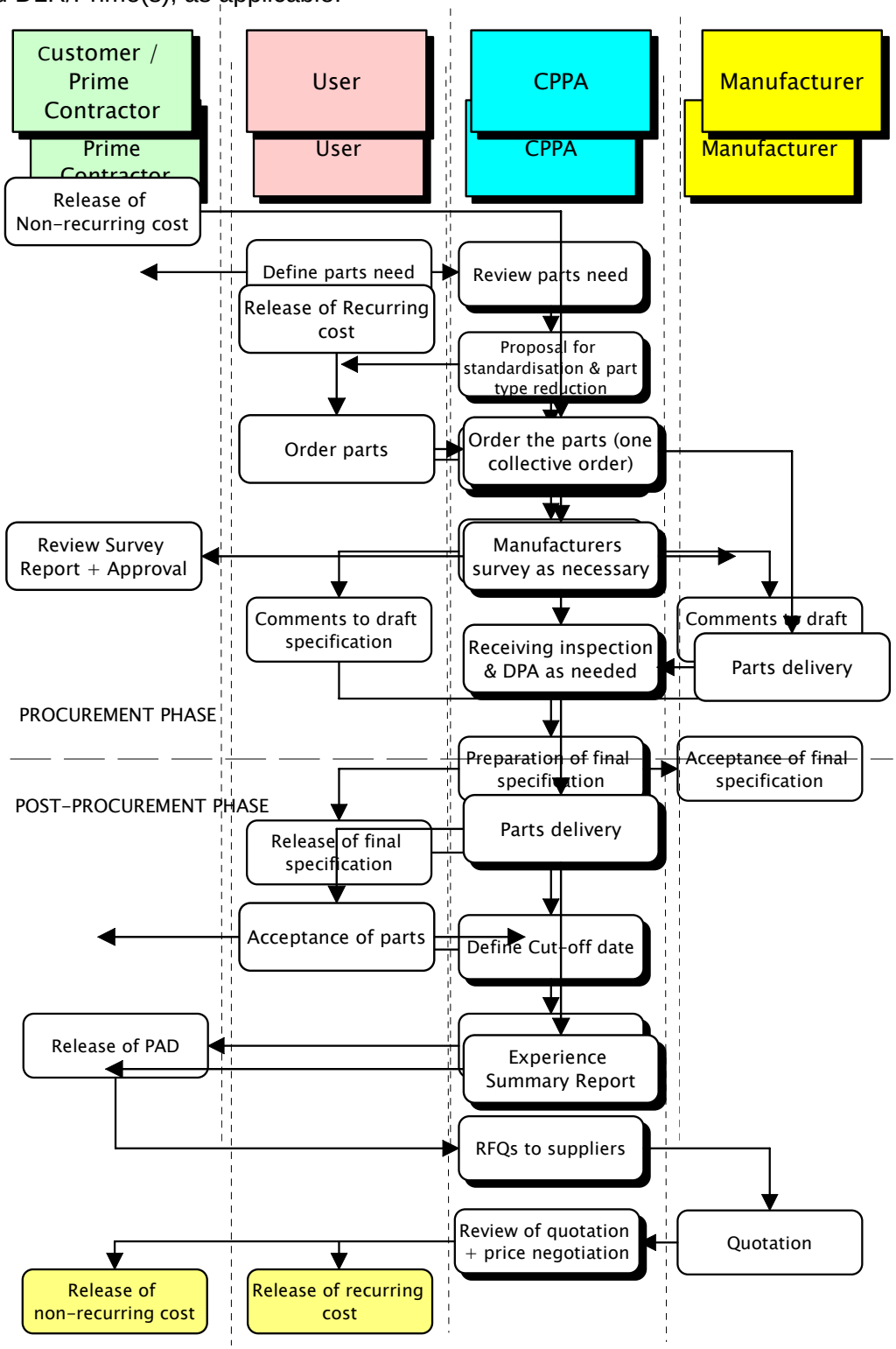

Chart 2: Pre-Procurement Work Flow

Chart 3: Procurement & Post Procurement Work Flow

4.5 Parts Selection Rules

4.5.1 General

The selection of suitable EEE parts intended for use in space flight hardware is primarily a task of the involved users or experimenters. To assure that these parts are capable of meeting the performance, quality and reliability requirements defined for the <PROJECT> programme it is essential that a supervisory authority controls the part selection process. This task is carried out by the CPPA and the PPCB on behalf of the prime contractor(s) and/or the DLR as applicable.

The users or experimenters shall select their part types in the following order:

- Commercial parts having passed or capable of passing the assessment procedure [A4]
- Commercial parts considered suitable for specific project application together with a risk analysis and management in accordance with the procedures defined in [A5] when the assessment per procedure [A4] could not demonstrate the part's full acceptability for general space use.
- Standard space level parts listed on relevant QPLs or QMLs as qualified parts (ESA/SCC, CECC, MIL, NASA) and on approved project parts lists of space programmes with similar application and procured to the same or higher screening levels as required for this project.
- Non-standard parts approved for European space programmes.
- Other parts that have met the requirements of non-European standards for space flight use.

All such parts shall be approved by the PPCB for use in the <PROJECT>programme.

4.5.2 Commercial Parts

Commercial parts are very attractive in terms of unit cost and short term availability and often are even better in quality and reliability than traditional space level parts. Commercial parts, however, cannot be used on the spot without having demonstrated their suitability for the intended space application with radiation aspects playing an important role.

Therefore, foreseen commercial parts shall be submitted to a space application suitability assessment in accordance with the assessment procedure [A4] which may categorise them as:

- suitable for general space use
- for specific project use
- or as not suitable.

If the initial assessment could not undoubtedly demonstrate the suitability of a part, a risk assessment and risk management – carried out per [A5] – may provide sufficient confidence in the use of such parts. If the assessment has determined that acceptability of commercial parts can be achieved only after performance of any additional screening, delta testing or inspection, ... etc., final acceptability will be established upon successful completion of these activities.

4.5.3 Standard Space Level EEE Parts

The selection of standard space level components shall be considered only when a suitable commercial part type does not exist for the needed electrical function or performance characteristics or when existing, cannot withstand the harsh environmental conditions in space, i.e. in particular do not provide the radiation tolerance or hardness required for the mission even if all possible risk mitigation measures have been considered. Such constraints are primarily applicable to active (semiconductor) device types.

The disadvantage of such "standard" part types is their considerably higher unit cost associated with longer delivery times and the limited availability of advanced, state of the art technology and

high complexity parts. Never-the-less, a certain share of standard space level parts will always be required particularly when radiation hardened (or tolerant) parts are needed, the required level of which is determined by the satellite's or spacecraft's orbit and mission time.

4.5.4 Non-standard Parts

The selection of non-standard parts shall be based on the existing heritage regarding technical performance, quality and reliability records and history of previous use in similar applications. It shall be considered only if suitable candidate parts could not be found in the aforementioned categories. Users shall be required to provide appropriate justification and technical rationale to the PPCB.

5 PARTS PROCUREMENT - GENERAL

All requirements of this parts procurement plan shall apply to the components for flight hardware but may also be required for the components of any ground support equipment with a physical interface to the spacecraft or equipment. They are principally applicable during the entire duration of the parts procurement activities but with a varying extent during the three phases, which are addressed in detail in sections 6, 7, and 8 of this plan.

Further, as the SOW encourages the maximum use of commercial parts, this plan will also include specific aspects and requirements for such parts and provide a description where and when the approach deviates from standard routines applicable to traditional space level components.

5.1 Starting Activities

5.1.1 Preparation / Adaptation of an EEE Parts Data Base

A main tool in the management and control of parts procurement activities is an EEE parts data base operated by the CPPA that covers a wide range of parameters and characteristics for all the parts and projects contracted to the parts procurement service. It shall be flexible to handle any number of users and parts and is used to support the technical and the commercial activities of EEE parts procurement. Further, it can be easily extended and adopt parameters and requirements according to the <PROJECT> programme's need.

Some adaptation will be required to cover the amount, species and style of data for commercial parts, because the existing data base so far has handled primarily standard space level parts, and to input all users and equipment foreseen in the <PROJECT> programme.

In addition, this system is tailored to automatically generate reports for every procurement status which can be exported to an Internet web site on periodic basis. In that way, up-to-date visibility of the status of the parts procurement is continuously available to all users and customers involved in the project.

Further, the system can export data in a wide variety of data formats to facilitate analysis of the data in other tools or to communicate data to users or customers.

The standard reports that are available are Master Procurement List (MPL), Purchase Order and Shipment Status Lists.

5.1.2 Internet Reporting

The internet provides an efficient means of communication for EEE parts procurement projects. Reports, specifications and numerous other documents needed for effective communication can be made available to both customers and users via the internet.

The CPPA will to set up an appropriate web-site adapted to the needs of the <PROJECT> project. It will enable all participants to review documents on-line, print or download the documents to the users' computer. Access control will be realised through the use of passwords to allow full visibility of data for the prime contractor(s) and/or the DLR and restricted or filtered visibility for the users as relevant for their own parts.

Access to the CPPA's internet reporting system can be obtained by clicking the button for EEE parts procurement at:

http://XXXXXXXXXXXX

The data shall be presented as *.PDF files that can be opened, viewed and printed using the ACROBAT READER software. The reader can be downloaded free of charge by any internet user from the ADOBE web-site.

By making the actual and up-to-date status of the parts lists and the procurement activities available to the prime contractor(s) and/or the DLR and the users via the internet, the CPPA can ensure that every party involved is working on the same baseline.

Technical documents which are written specifically for the <PROJECT> project such as procurement specifications or documents will be copied to the internet server.

Hardcopies will be sent in parallel to the DLR, the prime contractor(s) and the user(s) involved as required in the DRL of the SOW.

5.1.3 Establishing of the Master Procurement List (MPL)

The CPPA will collect all user parts lists and compile them to an initial draft of a consolidated project parts list which will be converted to a Master Procurement List (MPL). This MPL will be further refined by a standardisation and type reduction exercise. It will be used to control and monitor the procurement activities in terms of technical aspects, part types and quantities, cost and schedule during the entire duration of the programme.

The content of the MPL shall meet the requirements of DRD-10 of the SOW. As the technical data and information collected for commercial parts may not be fully compatible with the format or template set for standard space level components, the CPPA will make an appropriate proposal to the prime contractor(s) and/or the DLR after a sufficient number of commercial part types have been assessed for their space application suitability in the <PROJECT> programme.

5.1.4 Updating of the Parts Procurement and Control Plan

Once approved this parts procurement and control plan will be updated and submitted for approval to the prime contractor(s) and/or the DLR when specific project requirements have changed or when major programme policy changes have to be implemented. When this invalidates the proposal for the CPPA activities such changes must be covered by a corresponding Change Notice (CN) to the contract.

5.2 Procurement Control

The project manager for the <PROJECT> procurement project will use the following tools to implement the project control and to ensure optimum performance during the course of the project.

Internal Review Meetings

These meetings will be held periodically at the CPPA and shall be supported by telecons with users or experimenters, the prime contractor(s) and/or the DLR as necessary. The following points will be reviewed:

- Parts selection status
- Technical items (PAD status, specification status, evaluations, etc.)
- Procurement status (Quotations, purchase orders, received parts, etc.)
- Reporting status (Consolidated parts list or MPL, critical item list, progress reports, etc.)
- Cost status (Overall cost projection, etc.)

Action items will be identified and allocated to individual persons who shall implement the actions and report on the results in due time.

External Meetings

External meetings are such as PPCB, Progress, Users & suppliers meetings. Whenever possible such meetings shall be planned sufficiently in advance to allow all participants to make the necessary arrangements and meeting room reservations etc. and such announcements shall be complemented by a provisional agenda to assure availability of necessary expert personnel at the

meeting location and any other supporting data or information. Action items will be identified and allocated to individual persons who shall implement the actions and report on the results in due time.

Reports

The monitoring and control of the project is mainly supported by reports which will be generated (automatically) by the CPPA parts data base and presented on the internet web site. Such reports include progress reports, technical status reports, procurement status reports and cost status reports. These reports are used internally to control the work being carried out on the project.

Further the procurement will be controllable via the Master Procurement List (MPL) that will be updated every week.

To properly identify the critical items (technological and schedule) that could jeopardise the proper execution of the succeeding project phase, a management task for project planning (see section 6.1.4) will be established. The project planning will be assisted by a configuration and data management. By these management activities alternatives and back-ups will be prepared to mitigate the risk involved in the critical items encountered.

5.3 Procurement Specifications and Documents

5.3.1 General

For commercial parts procurement specifications in the traditional sense are non-existing. Such parts are typically manufactured to a supplier's data sheet which may be subject to changes without prior notice. Moreover, commercial parts are often not available directly from the manufacturer but only from authorised distributors. Therefore, for such parts a procurement approach must be chosen that deviates from that for standard space level parts and which is described hereafter.

5.3.2 Procurement Documents for Commercial Parts

In contrast to the standard space level components it is impossible to order commercial parts from the suppliers on the basis of a single procurement document which adequately defines all requirements necessary to ensure the suitability of a parts for the intended space application.

Instead, the primary and often the only reference will be the manufacturer's data sheet or part of a data book (the latter of which may present further information and data required, e.g. manufacturing flow, reliability data and statistical records, application notes or guidelines, operating instructions, programming routines, ... etc.). Therefore, it is essential that all used or invoked documents and data sheets, etc. are under configuration control and bear, as a minimum, an issue and issue date reference that can be invoked in a purchase order issued to the supplier or his authorised distributor.

Overall, the acquisition document(s) shall address the following as a minimum:

- Absolute maximum ratings including operating and storage temperature range of the parts
- Outline / package drawing, table of dimensions, pin configuration, lead finish and other mechanical parameters as applicable
- Electrical circuit and/or functional block diagram and pin allocation
- Electrical parameters and limits at room temperature and at temperature extremes
- Any delta testing required to establish the parts' acceptability (as identified during the space application suitability assessment), e.g. screening, burn-in, vibration or shock testing, ... etc.
- Drift limits for selected electrical parameters as applicable
- Criteria for percent defective allowable (PDA) if and as agreed upon with the parts supplier

- Marking and ordering information to address possible variants, electrical grades and tolerance options
- Protective packaging and handling precautions
- ESD sensitivity
- Radiation sensitivity if applicable

Any additional inspection, special electrical selection, screening or testing as deemed necessary during a space application suitability assessment of commercial parts will typically not be accepted by the parts suppliers except when a special agreement was reached with the manufacturer which incurs further test or screening charges.

Finally, as lot traceability is essential for active device types (down to wafer or diffusion lot for transistors and microcircuits), the acquisition documents shall include a single delivery lot Date Code requirement in writing, since otherwise the CPPA might be required to perform multiple mechanical or electrical tests and radiation sensitivity characterisations and DPAs as per the number of delivered sub-lots and as applicable.

Nevertheless, approval of commercial parts shall be made on substantiated and verifiable grounds and thus, any such part must have been submitted to a space application suitability assessment per [A4] and [A5], if and as applicable.

5.3.3 Procurement Specifications for Standard Space Level Parts

All EEE parts requiring standard space level quality levels or screening classes for whatever reason shall be procured in the most cost effective way to existing specifications readily available in the ESA/SCC and the CECC system, the MIL Specification system and the Established Reliability Specification System for passive EEE parts. Amendments to these specifications shall be avoided as far as practicable. Otherwise they should be available for review by the prime contractor(s) and/or DLR during PPCB- or dedicated PAD-approval meetings at the CPPA premises.

Existing specifications from CPPA and other sources (e.g. manufacturer in-house specifications or other procurement agents) meeting or exceeding the <PROJECT> programme requirements shall be treated in the same way and, therefore, also be available for review on this occasion.

5.3.3.1 New Specifications

When a procurement specification does not exist for a suitable standard space level part type, the CPPA will prepare an appropriate draft document for negotiation and final approval with the parts manufacturer, the user, the prime contractor(s) and/or the DLR. The format shall be equivalent to that used by the relevant manufacturer for similar part types, i.e. the ESA/SCC specification format for European suppliers or the format of the closest MIL performance or Established Reliability specification for US suppliers.

The specification shall include characteristics of the EEE part, tests, failure criteria and quality conformance requirements for the needed part in line with established rules and procedures.

Careful attention will be paid to the results obtained from an evaluation programme, such that recommendations made will be considered during the preparation of a specification. Special user requirements however, deviating from manufacturer's published data sheets should be made available to the CPPA preferably prior to establishing an evaluation plan but no later than during specification integration negotiations.

All specifications exclusively written for the <PROJECT> project shall be delivered to the relevant user(s), the prime contractor(s) and/or the DLR for approval.

5.4 Quality Levels & Screening Requirements

5.4.1 General

All parts intended for assembly into flight-standard hardware shall be capable of meeting the quality and reliability requirements for the intended <PROJECT> mission and the associated lifetime.

The SOW requirement that commercial parts shall be used to the maximum extent possible implies that as little extra and additional inspection, screening and testing as possible should be envisaged for the procurement of EEE parts to obtain the expected cost and delivery time advantage as compared to traditional space components.

Instead, maximum attention will be paid to check the adequacy of a manufacturer's processing and manufacturing steps for a particular technology and the associated quality system. If everything has been found satisfactory and the manufacturer can demonstrate that technology as qualified then all individual part types manufactured on this line should be considered qualified requiring no further screening and verification testing.

5.4.2 Commercial Parts

If the foreseen commercial parts have passed the space application suitability assessment per [A4], no further screening and verification testing shall be required.

If the assessment per [A4] could not fully establish a part's acceptability and a risk analysis and management exercise per [A5] has determined that the commercial part may be used with additional screening or lot testing only, final acceptability of such parts will be established upon satisfactory completion of the envisaged testing only.

It shall be performed preferably at the parts manufacturer's premises and the test requirements must be so designed that accumulated stress will not jeopardise the component's reliability. Alternatively, the required testing shall be carried out by the CPPA himself or under the CPPA's responsibility at an approved test house or laboratory. Failed or defective parts shall be removed from the lot. If the fall-out is unusually high the results shall be presented to the PPCB for a final acceptance or rejection disposition.

Accordingly, lot verification testing on a sample basis shall be required only if the manufacturer cannot provide a satisfactory quality record for the used technology and if similarity rules cannot be applied due to remarkable complexity differences of the compared components.

5.4.3 Hi-Rel Space Level Parts

When standard space level parts are foreseen, they shall be screened in accordance with the following requirements:

Component Types / Families	ESA/SCC Level	US MIL / Group Test	Complementary Tests
Std passive parts	C	ER-MIL, FRL P/R or B	
Non-Std passive parts	B	ER-MIL, FRL S or C	Relays: Millipore screening + miss test under vibration
Discrete semiconductor devices	B	MIL-PRF-19500, JANS / Group A, B,	
Microcircuits	B	MIL-PRF-38535, class S or QML V / Group A, B	

Component Types / Families	ESA/SCC Level	US MIL / Group Test	Complementary Tests
Hybrid circuits + chips	PSS-01-608, Test level B	MIL-PRF-38534, class K / Group A, B	

When manufacturers of space level parts are offering the parts to an equivalent in-house flow with non-value-added testing deleted, this option shall be given preference because a cost advantage is usually applicable to those parts.

5.5 Radiation Requirements

Parts selected for flight hardware in the <PROJECT> programme shall be capable of meeting the following minimum radiation characteristics which are primarily relevant for active devices types:

Total Dose: 10 krad(Si) - assuming TBD mm inherent Aluminium shielding and a mission time of ≥ 5 years

SEL: parts shall be immune to Single-Event Latch-up for LET values <110 MeV.cm^2/mg

SEU: parts shall be immune to Single-Event Upset for LET values < 36 MeV.cm^2/mg

SEGR: parts shall exhibit no SEGR at 100% VDS and LET = 40 MeV.cm^2/mg

SEB: parts shall exhibit no SEB at 100 % VDS and LET = 40 MeV.cm^2/mg

Note: When the component radiation sensitivity, as obtained either from radiation characterisation test or existing radiation resistance data, is less than 1.3 times of the above minimum anticipated dose, samples from the lot or wafer under procurement shall be subjected to **a Radiation Verification Testing (RVT)**. This shall be indicated accordingly on the corresponding PAD.

5.5.1 Radiation Hardness Assurance Provisions for Commercial Parts

For standard commercial part types typically no radiation hardness or tolerance data is available. Therefore, radiation hardness characterisation testing must be envisaged as early as possible in the EEE parts selection phase when the type reduction and standardisation exercise could not identify a suitable radiation hard or tolerant replacement part for the needed function and the space application suitability assessment per [A4] and [A5] has indicated acceptability of the part on condition that the minimum <PROJECT> project radiation requirements can be met.

Therefore, the CPPA shall order a suitable quantity of commercial test samples (TID testing: 5 pcs for irradiation and 1 pc as control sample) for radiation characterisation testing. Further, he shall obtain a (written) confirmation from the manufacturer that the purchased samples reflect the most recent processing and manufacturing flow implemented in the applicable facilities (i.e. wafer fabrication and assembly line).

If radiation characterisation yields acceptable results (allowing use of the parts at least with spot shielding), the PAD can be prepared accordingly and submitted to the PPCB for approval. At this point in time the CPPA shall open or de-cap one of the irradiated samples and make a (high resolution) photograph of the die surface to allow comparison with parts ordered later for FM application and verification that the parts appear to be manufactured with the same mask set as the radiation characterisation test samples. This implies that the CPPA repeats the same action as soon as the parts of the “FM”-order have been received at the CPPA’s premises and prior to any further receiving inspection activities.

Alternatively, the parts manufacturer could be required to issue a confirmation that radiation test samples and “FM”-part originate from the same wafer fabrication and manufacturing processes (or even better: the same wafer lot or wafer).

RVT should be carried out on parts from the FM lot when the safety factor of 1.3 cannot be met with respect to the above minimum parts radiation characteristic. If the single lot date code traceability requirement has not been observed by the manufacturer, a larger RVT sample may be required covering all lots. In such a case the necessary safety factor (SF) may be increased according to the number of different lot date codes delivered, e.g.

- Single lot SF 1.3
- 2 lots SF 2.0
- ≥ 3 lots SF 5.0

Necessary details shall be identified on the PADS.

5.6 Components from Stock

Components from stock may be used for the <PROJECT> project if they can be demonstrated to meet the following conditions:

a) The Lot date code indicates that **less** than **5 years** will have elapsed from the date of manufacture to the anticipated shipment date to the user(s) [for parts from CPPA stock] or to the date of intended installation on equipment [for parts from user stock] **and**

- the <PROJECT> quality requirements specified in this plan and verified by a data review will be met,
- and DPA shall be performed, when

(i) it would be normally required but no available DPA report covers the lot

(ii) degradation of the components during storage may have occurred

b) The Lot date code indicates that **more** than **5 years** will have elapsed from the date of manufacture to the anticipated shipment date to the user(s) [for parts from CPPA stock] or to the date of intended installation on equipment [for parts from user stock]. For such components the following shall be performed:

- Electrical test of ageing sensitive parameters on a sample basis (AQL = 0,65, level II)
- Visual inspection (AQL = 0,65, level II)
- seal test, when applicable (AQL = 0,65, level II)
- DPA shall be performed in cases where:

(i) It would be normally required but no available DPA report covers the lot

(ii) degradation of the components during storage may have occurred

5.7 Specific Components

Specific components of new technology and high complexity require specific attention because extra screening and/or verification testing may be needed as detailed on the relevant PADs.

5.7.1 Application Specific Integrated Circuits (ASICs)

ASICs preferably shall be procured from suppliers who are capability or technology approved for the selected technology. Further, ASICs from European vendors with QML approval shall be given preference if they offer a cost and/or schedule advantage. Accordingly, for ASICs from the US preference shall be given to QML listed suppliers.

Generally, special attention shall be paid that test vectors during electrical tests are chosen such that appropriate fault coverage is assured. Further, ASICs should be manufactured in a technology

which provides sufficient radiation hardness or tolerance to TID and SEE in line with the minimum <PROJECT> programme requirements.

5.7.2 Hybrid Circuits

Hybrids preferably shall be procured from suppliers who are either capability or technology approved or have QML approval for all relevant technologies.

Special focus shall be put on the appropriate selection of the add-on components by the supplier and appropriate environmental and mechanical testing (e.g. vibration and shock testing). Also a CA may be required on representative sample parts to verify the internal integrity and appropriate workmanship.

Active components employed in the hybrids should be manufactured in a technology which provides sufficient radiation hardness or tolerance to TID and SEE in line with the minimum <PROJECT> programme requirements.

5.7.3 Programmable Devices

Specific requirements will be established to cover the programming at the manufacturer or user site and any post programming screening (burn-in and/or life testing) and corresponding electrical testing. Further, such parts should be manufactured in a technology which provides sufficient radiation hardness or tolerance to TID and SEE in line with the minimum <PROJECT> programme requirements.

Note: users shall be made aware that programming yield may be less than 100% and thus, appropriate attrition should be considered when calculating need quantities for FM parts.

5.7.4 Material Requirements for EEE Components

In the case that non-hermetically sealed components are applied the manufacturer shall ensure that he only uses materials that meet the requirements of ECSS-Q-70 regarding outgassing, flammability, toxicity and/or other criteria required for the intended use.

5.7.5 Components Requiring Specific Authorisation

The use of components with the following characteristics **shall be prohibited** except where specifically agreed on a case-by-case basis:

a) Components containing materials as for example:
   - Beryllium-Oxide
   - Cadmium
   - Lithium
   - Magnesium
   - Mercury
   - Radioactive Materials
   - Pure Tin (electroplated or fused)

b) Components with limited life, known instability, safety hazard and/or reliability risk.

   Examples of such parts are:
   - Hollow core resistors or capacitors
   - Potentiometers

- Non-metallurgically bonded diodes, except Schottky barrier and ultra high frequency diodes and other agreed case-by-case basis in the PAD
- Non-solid tantalum capacitors with silver case
- Dice without glassivation
- Non-passivated power transistors
- Wet-slug tantalum capacitors except for CLR79 construction using double seals and tantalum case
- any parts whose internal construction uses metallurgic bonding with a melting temperature not compatible with end-application mounting conditions, except for some special applications to be agreed on case-by-case
- wire-link fuses

5.8 Traceability

The level of traceability which a manufacturer maintains for its components can be assessed on the basis of:

- A manufacturer's statement, made in response to a request for information, which describes the traceability which he maintains.
- A manufacturer's quality assurance manual, manufacturing manual, or documented procedure(s) which describe and control the actions taken during component manufacture to maintain traceability.
- A sample of any documentation (traveller) which is produced for, and which accompanies, a production lot and which demonstrates the level of traceability.

As a minimum the following conditions should be met for considering the traceability aspect satisfactory:

a) The expression "lot" must be well defined in the manufacturer documents.

b) The definition for one individual lot shall be such that different designs, die constructions, production lines or facilities are excluded for a specific component type.

c) The definition for one individual lot shall be such that the parts will be made out of the same materials charge and manufactured according to the same processes.

d) The manufacturing or testing lots or dates shall be determined and the associated personnel, equipment and data shall be recorded.

e) Data and documents shall be retained by the manufacturer for a minimum of 5 years.

For standard space level part types traceability during components manufacturing and testing will be covered by the procurement specifications. This traceability will be maintained by the CPPA from receipt of the parts and incoming inspection until shipment to the users in accordance with the <PROJECT> programme PA requirements.

5.9 Handling and Storage of Parts

Procedures for handling and storage of components to prevent possible degradation will be established and implemented. As a minimum the following rules shall be observed:

Temperature, humidity and cleanliness during handling and storage of parts shall be controlled.

Devices that are susceptible to damage by electrostatic discharge shall be handled with special care. Suitable precautions shall be employed for protection during all phases of manufacture, test, packaging, shipping and handling.

Note: When plastic encapsulated devices (PEDs) shall be delivered to the users, a notification shall be included with the delivery that such parts must be submitted to special preparatory steps prior to assembly - for guidelines see [R3].

Mandatory precautions valid for all EEE part types are detailed hereafter:

a. Devices should be handled on benches with conductive and grounded surfaces
b. Ground test equipment and tools
c. Do not handle devices by the termination.
d. Store devices in conductive foam, carriers or boxes.
e. Avoid use of rubber or silk in the fabrication and assembly areas.
f. Maintain relative humidity above 50%, if practical.
g. Ground all handling personnel with a conductive bracket through a 1.0 MΩ resistor to ground.
h. Store chip devices (naked dice) under dry nitrogen.

5.10 Parts Approval and Parts Approval Document (PAD)

A special parts approval document (PAD) has been developed to cover the large variety of possible inputs for commercial parts. It is, however, also usable for standard space level parts [see Appendix 1].

As commercial parts should have successfully passed a space application suitability assessment per [A4] and possibly also with a risk analysis and risk management measures per [A5], these assessment forms shall complement the PAD as necessary – [see Appendix 2]

For traceability purposes the CPPA will issue PADs for **all** part types, i.e. for standard **and** non-standard parts needed in the <PROJECT> programme, although formal approval of standard parts' PADs by the prime contractor(s) and/or the DLR is not required.

If it is not intended to issue a project PPL, a reference shall be given on the PAD from which QPL, QML or other approved project parts list a classification as "standard" part can be derived - see also section 3, Definitions – [STDP].

5.11 Procurement Status Reporting

In addition to the procurement list containing all information necessary to establish the procurement status of each line item (order, pre-cap date, delivery dates, etc.) the CPPA will issue a progress report in line with the SOW [DRD-4] and the <PROJECT> project requirements as applicable.

The report shall cover the following subjects or areas:

1. Introduction / General situation

   The overall status of the procurement / programme for individual components / line items

   The summary schedule

   The status of the user lists

   The type reduction and standardisation status

   The (draft) MPL and EMPL status

   The current activities and details of any specific problem or anticipated problem areas and recommendations for their resolution.

2. Status of assessment, risk analysis, risk management, evaluation / qualification activities as applicable
3. Visits and/or audits planned and performed and the results
4. Status of specification preparation and negotiation with users & manufacturers
5. Status of PADs
6. Status of user P/Os and corresponding cut-off dates
7. Status of P/Os placed by the CPPA
8. Status of NCRs and/or RFW/RFDs and/or Failure Analyses as applicable
9. Alert review as applicable
10. Action item status list
11. Status of parts received at the CPPA (receiving inspection, data review, DPA)
12. Status of parts deliveries to users
13. Future planning (overall procurement & delivery schedule, short term activities, meetings)
14. Contracts and Finance (Contractual aspects / cost and payment status)
15. Action items
16. AOB / Miscellaneous
17. Annexes

5.12 <PROJECT> Parts Co-ordination Board (PPCB)

5.12.1 Task and Responsibilities

The <PROJECT> Parts Co-ordination Board (PPCB) will be established as a technical advisory board to the prime contractor(s) and/or the DLR.

The PPCB responsibility is to give primarily technical recommendations to the prime contractor(s) and/or the DLR, within the field of activities defined for the PPCB and its assigned objectives and also to familiarise the users with all aspects, rules, duties and responsibilities of the <PROJECT> parts procurement.

The PPCB will determine parts standardisation and consolidation, part types reduction and definition of all required information for the PAD approval. In addition identification of any other tasks, like components evaluation, specification writing, manufacturer assessment, recommendation for approval to the prime contractor(s) and the DLR and special tasks for the CPPA will be addressed and handled by the PPCB.

The agenda for each PPCB meeting will be proposed by the chairman who arranges and organises the meeting. The meeting location will be the CPPA premises unless otherwise required and agreed upon.

5.12.2 Members and Participants

The identified members are the prime contractor(s), the DLR, the CPPA and representative(s) of the user(s) if and as necessary. If user representatives shall have voting rights this will be discussed and agreed upon at the beginning of such PCB meetings. The PPCB will be chaired by the DLR representative or appointed agent or deputy.

5.12.3 CPPA's Activities

The CPPA will participate in the PPCB meetings. In line with the project requirements, he has a twofold function

- To actively support the PPCB decisions with their technical expertise and long term procurement experience yielded in both, commercial satellite programmes as well as DLR programs acting as a procurement agent.
- To act as a recipient of instructions from the prime contractor(s) and/or the DLR through the PPCB and furnish appropriate information and requirements to the users as necessary. The CPPA will also act as a single point contact to the respective manufacturers.

The CPPA will issue the draft MPL as a baseline for a consolidated parts list to the PPCB. This draft MPL will be subject to periodic iterations as the standardisation and consolidation or type reduction process progresses.

Further, the PPCB is also responsible for making decisions whether specific part types shall be considered as self-procured (by a user) or in-house manufactured, while all common parts shall be procured by the CPPA.

The CPPA, represented by the project manager and in relevant cases assisted by the deputy project manager or the engineering manager, will implement the decisions of the PPCB to the best of their ability,.

5.13 Deliverables

5.13.1 Hardware Delivery

All flight parts shall be delivered in the needed and ordered quantity and quality to the users.

Parts not delivered to the users, i.e. overrun parts from Minimum Order Quantities (MOQ), LAT or QCI/TCI samples and other special test samples (e.g. for RVT), which have been subject to destructive testing, shall be kept at the CPPA for at least TBD years unless otherwise directed by the prime contractor(s) and/or the DLR.

5.13.2 Document Requirements during the <PROJECT> Co-ordinated Procurement

In line with the requirements of the SOW [A1] a number of different documents, status lists and reports are required to be submitted to the involved parties during the entire execution of the <PROJECT> programme - with a varying number of copies and varying frequency or periodicity.

For the purpose of easy reference all required documents are listed hereunder in the Document Requirements List (DRL). The assignment to the three procurement phases is self-explaining for the majority of the documents together with the provided comments or remark. Documents confined to one or two phases only will expressly be mentioned in the appropriate section later in this plan.

All procurement documents and procurement specifications (for standard space level parts) will be available for review by the prime contractor(s) and/or the DLR at the CPPA premises. Copies of the procurement documents or specifications established for commercial parts will be provided to the users as necessary. Publicly available specifications (e.g. ESA/SCC, MIL-specifications, ... etc.) will not be distributed.

Table 1: Document Requirements List (DRL)

DRD No.	TITLE	PROP	PCB	DLR	USER	PRIME	FREQ (paper copy)	EF/IR
1	Parts Procurement & Control Plan	X		3		3		EF
2	Planning of Procurement Milestones	X	X	3	1	3		EF
3	Cut-off dates		X	1	1	1		EF/IR
4	Procurement Progress Report			2		2	3 months	EF/IR
5	Minutes of Meeting (MoM)		X	1	1	1	1W after meeting	EF
6	Action Item Status List		X	1	1	1	PR	EF/IR
7	WBS & WPD	X		1		1		EF
8	Document Status List			1		1	PR	EF/IR
9	Technical Note			1	(1)	1	As needed	EF
10	Consolidated Parts Procurement List / Master Procurement List (MPL)		X	1		1	PR	EF/IR
11	User specific Extract of the MPL (EMPL)		X		1		PR	EF/IR
12	Long Lead / Critical Item List	X	X	1	1	1	PR	EF/IR
13	CPPA Purchase Order List		X	1	1	1	PR	EF/IR
14	Shipping List			1	1	1	PR	EF/IR
15	PAD Sheets + Assessment sheets		X	1	1	1	As soon as available	IR
16	Parts Procurement Specifications / commercial parts acquisition documentation		X	1	1	(1)	PCB	EF
17	Parts Evaluation Plan		X	2	(1)	2		EF
18	Evaluation Test Reports		X	1	1	1		EF
19	Parts Qualification Plan		X	2	(1)	2		EF
20	DPA Report			RV	CoC	RV		EF
21	DPA Status List			1	1	1	PR	EF/IR
22	Non Conformance Report (NCR)		(X)	1	(1)	1		EF/IR
23	Failure Analysis Report		(X)	1	(1)	1		EF
24	NCR Status List			1	(1)	1	PR	EF/IR
25	RFW / RFD			1	(1)	1		EF
26	RFW / RFD Status List			1	(1)	1		EF/IR
27	Radiation Characterisation Test Plan	X		1	(1)	1		EF
28	Radiation Verification Test (RVT) Plan	(X)		1	(1)	1		EF
29	Alert / Problem Notification		X	1	1	1	As soon as available	EF
30	Audit Report		(X)	1	(1)	1	1week after audit	EF

DRD No.	TITLE	PROP	PCB	DLR	USER	PRIME	FREQ (paper copy)	EF/IR
31	Experience Summary Report			3		3	On completion of programme	EF
32	Expenditure / Cost Status			1		1	ditto	EF/IR
33	List of stock parts			3	(1)	3	ditto	EF/IR

Notes / Legend: Number of copies for

PROP	Proposal
PPCB	<PROJECT> Parts Co-Ordination Board
DLR	Customer
PRIME	Prime Contractor
FREQ	Frequency of required submission of hardcopy
PR	with Progress Report
EF/IR	Electronic File / Internet Reporting (periodic [= weekly] updating)
(X)	as applicable
RV	report available for Review

6 PRE-PROCUREMENT

The pre-procurement phase extends from the kick-off of the C/D phase up to the placement of purchase orders to the manufacturers.

6.1 Management Tasks

6.1.1 Co-ordinated Parts Procurement

The user needs (identified by the users' declared parts lists - DCLs) will be collected and integrated by the CPPA into a consolidated parts procurement list - the Master Procurement List (MPL). Extracts from the MPL (EMPL) filtered for each individual user's parts will be distributed to the users in electronic format for confirmation.

In addition, CPPA will set up an internet web site dedicated for the <PROJECT> project. Both, procurement information as well as technical documentation will be made available to all parties involved in the project via that web site. This site can be accessed by means of a password. For users the access to the data will be restricted to the data relevant for the user. Updating of the list will be performed weekly.

Further, a hardcopy of the MPL will be distributed to the prime contractor(s) and the DLR prior to the scheduled progress meeting.

6.1.2 Identification of Long-Lead Items (LLI) / Critical Items

The long-lead items/critical items identification activity is a main task of the pre-procurement phase and will be handled with the appropriate priority. All information along with LLIs will be made available to the PPCB for assessment.

During evaluation of the supplier information, long-lead items will be identified. Long-lead items are those parts for which procurement time + turn-around time at CPPA jeopardises availability of the part at the user need date. CPPA will identify all those long lead items and propose solutions to keep the schedule when possible.

The planning of all tasks associated with EEE parts procurement will be done by means of a master schedule. Each of the components identified for the <PROJECT> procurement will be allocated to a procurement block depending on the category of the component and the typical lead times for the delivery of the part. The lead times are a result of past experience and are in many cases much longer than the delivery times quoted by the manufacturers. In addition to the manufacturers lead times additional time has to be allocated for the CPPA activities. Typically 6 weeks prior to ordering and 5 weeks after delivery by the manufacturer have to be foreseen.

Except for long lead items, also items which bear a risk from technology point of view during procurement and later application and items under evaluation will be identified as critical items. This list will be a result from recent projects of the CPPA. The risk involved will be addressed and a solution shall be proposed.

Moreover items with a high cost impact will be listed.

6.1.3 User Frame Purchase Order Conditions

The purchase orders for users to the procurement agent (CPPA) under the <PROJECT> programme shall contain the clauses worked out and agreed with all users.

6.1.4 Planning

The procurement of parts in each block (refer to section 7.1.1.1) is regulated by determining freeze dates and cut-off dates.

The master schedule, containing these freeze and cut-off dates, will be updated monthly and submitted to the prime contractor(s) and/or the DLR for review and to users for information. Each potential problem will be highlighted and an action item list prepared, reflecting the resolution proposal and/or corrective action. The description and status will be addressed in the monthly progress report.

6.1.5 Support by and Reporting to DLR/Prime

During the execution of the co-ordinated parts procurement the prime contractor(s) and/or the DLR act as the technical authority to approve PADs, specifications, evaluation programmes and others.

During pre-procurement phase the following documents, extracted from Table 1, will be delivered to the prime contractor(s) and/or the: DLR

	Prime contractor(s) and/or DLR		
DOCUMENT	A	R	I
Planning of Procurement Milestones	x		
Cut-off dates (monthly)		x	
Progress reports		x	
Consolidated parts procurement list - MPL		x	
CPPA Purchase Order List			x
Long-Lead Items/Critical Items Status		x	
PAD Sheets	x		
EEE Procurement Specifications	x		
Evaluation Plans	x		
Evaluation Report		x	
Radiation Verification Plans	x		

A = Approval R = Review I = Information

Recipients, number of review copies and frequency of submission shall be as per Table1.

6.2 Parts Engineering Tasks

6.2.1 Review of Parts Need

The CPPA's parts engineering group will recommend parts which are capable of meeting the operating, environment, safety, radiation and reliability conditions of the <PROJECT> programme.

For non-standard parts, the CPPA will also ensure that suitable manufacturers are selected and approved by the prime contractor(s) and/or the DLR. A manufacturers surveillance and control during procurement will be performed in accordance with the procurement documents and as indicated on the purchase order. For commercial parts pre-cap and final CSI or buy-off inspections are generally not feasible unless specifically agreed upon with a parts manufacturer.

6.2.1.1 Standard Parts

Parts recommended for use in the flight equipment should be standard parts identified on the <PROJECT> Project Preferred Parts List or - if no PPL is available and the preparation of a project PPL is not foreseen - as defined under section 3.1.1, Definitions [STDP].

6.2.1.2 Non-standard Parts

The selection and use of non-standard parts shall be avoided whenever possible.

Otherwise and especially if new types need to be procured due to equipment design requirements, obsolete technology, discontinued production or procurement problems (quality, schedule etc.) with a particular manufacturer, the selection/recommendation of non-standard parts will be based on the following criteria:

- the availability of a part type within the <PROJECT> project schedule
- the technological design of the part type and criticality, if any
- the experience with the procurement source
- the ability to withstand a radiation environment as described in the <PROJECT> Space Radiation Environment Specification [A3] for total dose and to be immune to SEU and Latch-up.
- minimum cost incurred (parts cost + assessment efforts)

To the selection of non-standard components, the CPPA will issue recommendations to the users based on the knowledge regarding technical performance, suitability for and history of previous usage in similar applications. Preference will be given to components from sources which would require the least assessment and/or risk mitigation efforts.

6.2.1.3 Radiation Sensitive Parts

Parts will be reviewed to establish their susceptibility to radiation in terms of:

- total dose effects
- cosmic ray effects (heavy ions)

and referring primarily to all active electronic parts, i.e. diodes, transistors, ICs, hybrids. Passive parts, however, will only be reviewed, when their technology is completely different compared to passive parts used so far without restrictions and thus, no representative radiation test data is available.

The radiation tolerance of EEE parts will be assured by first starting a review of the information available for the individual parts. This information shall include data on the technology applied and on test results achieved on parts from the same technology and/or on similar part types (refer also to [A3]).

The CPPA will review the part type whether radiation testing for a particular part type will be proposed or not. If so, the extent of testing deemed necessary will be detailed. Depending on the availability of appropriate radiation characterisation data CPPA will propose total dose type- and/or lot evaluation and/or cosmic ray (SEU/SEL) testing as applicable.

If however, radiation sensitivity characterisation data do not exist for a particular part type – as is anticipated for the majority of commercial part types - and the used technology is not categorised a priori "insensitive", radiation testing will be envisaged and proposed for this type. This shall be carried out in accordance with the general approach described in section 5.5.1 of this plan.

Further, as it may be intended to use characterised commercial parts in other programmes, it shall be discussed with the prime contractor(s) and/or the DLR, whether or not a full radiation characterisation shall be carried out (TID up to 100 krad(Si) or at least to functional failure) for establishing a reference data base for commercial parts.

Finally, if any of the selected part types cannot meet the <PROJECT> programme's radiation requirements, the user is required to consider circuit hardening techniques.

6.2.1.3.1 Total Dose

All EEE parts shall meet the assessment criteria per section 4.2.4 of the space application suitability assessment [A4] unless otherwise defined in the Space Radiation Environment Specification for the <PROJECT> Programme Mission per [A3].

Without any spot shielding this minimum TID tolerance level shall be:

$TID_{min} \geq$ TBD Krad (Si)

Parts with a radiation design margin less than the minimum limit specified in [A3] could be authorised by the prime contractor(s) and/or the DLR for the program if it is not possible to identify other parts meeting that minimum received dose. In these cases a request for waiver will be submitted supported by the following justifications:

- analysis for radiation hard alternatives
- full radiation characterisation data for the component in question including response over a range of dose rates and bias conditions together with post irradiation effects
- justification for usage supplied by the user

The user shall also provide shielding provisions – if any foreseen - and tolerance of the circuitry to degradation effects by radiation.

The test steps to be considered for parts which have to be submitted to total dose characterisation testing shall reasonably distributed over 2 times the range determined by TID min, for a verification testing the part have to verify functionality without parametric failure for 1.2 times of the received dose. The test shall be completed by a two step annealing (48 hrs @ 25°C & 168 hrs @ 100°C or max. storage temperature, respectively) .

When total dose testing of part types is foreseen which are sensitive to dose rate effects (primarily bipolar technology microcircuits) such testing shall be carried out with low dose rates (LDR) as defined in ESA/SCC Basic specification No. 22900 combined with the worst case operating conditions as either allowed by the procurement specification or as available from the relevant user(s).

6.2.1.3.2 Cosmic Rays

All parts, which may be affected by cosmic rays, will be investigated to assess their susceptibility level to:

- SEU (Single Event Upset)
- SEL (Single Event Latch-up)
- SEB (Single Event Burn-out)
- SEGR (Single Event Gate Rupture)

Parts are considered insensitive to cosmic rays effects or single event effects when they meet the following Linear Energy Transfer threshold limits unless otherwise specified in the Space Radiation Environment Specification for the <PROJECT> Programme Mission per [A3].:

- SEU: LETth $\geq$ 35 MeV.cm²/mg
- SEL: LETth $\geq$ 75 MeV.cm²/mg

Parts insensitive to Heavy Ion or Proton induced SEU will be selected. Where this is not possible an SEU analysis will be proposed in order to ascertain the equipment upset rate.

Devices demonstrating latch-up phenomena will not be proposed for use on the <PROJECT> program since it may result in catastrophic failures.

Radiation-hardened and SEB / SEGR enhanced families of N-channel MOSFETs with known V_{GS} dependent derating rules can be used. MOSFETs manufactured with a Non-radiation-hardened technology shall not be used for the <PROJECT> project.

6.2.1.4 Off-the-Shelf Components

Parts from existing stock may be proposed for use in the <PROJECT> program, provided that they were stored in a controlled area and meet or exceed the programme requirements defined in section 5.6.

Any deviations from the above rules will be indicated in the PAD and justified to the prime contractor(s) and/or the DLR for approval.

6.2.1.5 Unique and Self-Procured Parts

In special cases the PPCB can decide that unique component types with a single user only and small need quantities is procured by the user himself. Reasons for self procurement are:

- When a special experience of the user exists with the part and the manufacturer
- When direct contact between user and manufacturer is needed
- When tight co-ordination with the development is needed to suit the needs of the circuits conditions

6.2.2 Standardisation

6.2.2.1 Review of the User DCLs and the Draft MPL

After the user parts lists (DCLs) have been compiled and consolidated to the draft MPL, a data sheet or specification identification and data availability review has to be performed. In this context also the space application suitability assessment or qualification status of each part type, the manufacturer and the procurement documents / specifications will be reviewed and recorded.

The CPPA will screen the draft MPL for standard and non-standard parts. Commercial parts submitted to a risk analysis and risk management per [A5] may be categorised ‘standard’ – suitable for specific project use - upon successful completion of the analysis and any risk management measures introduced. For non-standard parts the CPPA will search for alternatives and suggest replacement with standard parts when they exist. In this case users will be requested to update their DCLs accordingly. Otherwise they must provide justification and technical rationale why a standard part cannot be used.

6.2.2.2 Part Type Reduction

In addition to the assessment or qualification status check, another important task is the standardisation and type reduction, to minimise the number of line items, evaluations and non-suitable parts that leads to a cost saving procurement. Upon review of the user DCLs, the CPPA will focus on identifying redundant, duplicate functionality and critical part types, which must not be used for the <PROJECT> programme. The CPPA will make replacement proposals and discuss them in a closed loop co-operation with the users, the prime contractor(s) and/or the DLR. These users will be requested to review their DCLs once again and consider either exchange by a proposed alternative part type or to consider - in the ultimate case – a re-design of the application circuit to meet the project requirements.

6.2.2.3 User Meetings

Meetings with the users will be required to review, discuss and standardise the EEE parts need of the individual users. Further, parts for self-procurement by the users can be determined at such user meetings.

Because of the large number of users involved in the <PROJECT> programme it is proposed to convene a global users meeting at the CPPA premises for all involved users as early as possible

after the commencement of the parts procurement activities. At the global users meeting, all general aspects of the schedule, technical requirements, organisation, purchasing, delivery, frame purchase contract and parts selection procedure will be presented to the users by the CPPA, the prime contractor(s) and/or the DLR, as applicable.

6.2.3 Consolidation of Parts List

6.2.3.1 Entering of user parts lists in the data base

The CPPA in-house EEE parts data-base has to cover a wide range of parameters and characteristics for all the parts and projects contracted to his parts procurement service. This database will be extended by entering all the information and parameters of the user parts lists for procurement in the <PROJECT> programme. This will enable to extract all the required reports and lists from the database for the current project.

An adaptation of the data base entries may be required to cover the specific aspects of commercial parts pertaining particularly to address the specific PAD sheets and the information foreseen or contained on them.

6.2.3.2 Issuing and Updating of the MPL

The CPPA will issue a consolidated parts list MPL compiled from the various user DCLs, containing all necessary procurement status information from order to delivery. The list will be compiled from the content of the CPPA database system and made available on the internet for access by the prime contractor(s) and/or the DLR (visibility of all data) and the users (visibility of data restricted for their own parts only) . The access to this data will be password protected. Updating of the MPL will be carried out weekly.

Hardcopy extracts of the MPL will be prepared by the CPPA for the periodic progress meetings as necessary and as indicated on the DRL.

6.2.4 Parts Evaluation

For commercial parts any ‘evaluation’ activities shall be confined to those key elements of the space application suitability assessment [A4], where missing information could be substituted, i.e.

- Mechanical performance characteristics (Vibration and Shock testing)
- Constructional performance characteristics (CA for design, materials and workmanship + outgassing properties
- Radiation (TID and SEE testing)

Further, should the PPCB determine that for any part type additional evaluation activities should be carried out, the elements of the ECSS-Q60A should be considered as guidelines, i.e.

- Design and application assessment
- Construction analysis (CA)
- Manufacturer assessment
- Specific evaluation testing

The necessary elements, test conditions, sample size, ... etc., shall be tailored to the specific <PROJECT> project needs under consideration of the budget and schedule constraints and be recorded in a short form “evaluation plan”.

6.2.5 Obsolescence Management

For a program described in the scenario section 1.4 and the indicated mission time of > 5 years no specific obsolescence problems are expected because manufacturers of standard space level components typically give sufficient advance notice of possible obsolescence with suitable

replacement options already identified. This would allow to still place a purchase order for a sufficient quantity of the needed part types or to direct users for checking the offered replacement type(s).

For commercial parts obsolescence may have a higher probability because the life cycles of advanced, state of the art components is typically much shorter than that of traditional space parts. As improved versions of commercial parts frequently offer enhanced functionality, new functions added and reduced power consumption, ... etc. such changes are usually realised by a die shrink, increased transistor or gate count, size and weight reduction ... etc. which are beneficial for terrestrial applications. This is not valid for space application of such parts because particularly tolerance to radiation effects is adversely affected by a die shrinking process iteration. Therefore, for commercial parts approved for procurement the CPPA - when issuing an RFQ - will ask the manufacturers whether or not the part type is planned for obsolescence within a e.g. two years time frame.

If the quotation does indicate a risk of obsolescence, procurement of such parts is not recommended and appropriate alternatives will be explored in close co-operation with the user(s) and the prime contractor(s) and/or the DLR.

6.3 Quality Assurance Tasks

Note: All activities listed under section 6.1 and 6.2 of the pre-procurement phase will be supervised by the Quality Assurance manager who may delegate some of the tasks to the CPPA engineering group when expertise parts knowledge is needed.

6.3.1 Procurement Documents and Parts Approval

The quality assurance manager for the <PROJECT> programme EEE parts procurement shall review the procurement documents prior to release, to verify the correct selection of the procurement source and appropriateness of their content.

Based on the given parts lists, the parts approval documents (PAD) issued by the parts engineering group will be reviewed by the quality assurance manager according to the project requirements.

6.3.2 Definition of Procurement Source and Back-up Solution

For each part type the procurement source and a back-up source (when available) will be indicated in the PAD. The quality assurance manager shall participate in and approve the selected procurement source/ supplier on the basis of the criteria defined in the document “Product Assurance Requirements for the <PROJECT> Programme / Satellite” [A2]. The quality assurance manager shall also support the CPPA in all activities along with surveillance and auditing of the procurement source if deemed necessary.

6.3.3 Assessment of and Inspections at the Manufacturer

The assessment of performance of the manufacturer gained in the different areas such as incoming inspection shall be reviewed. This can be done for example on the basis of incoming inspection records and defects found during electrical measurements or visual inspection which are maintained in a database to ensure traceability to historical data and quality trend. The quality assurance manager shall have access to the quality trends and shall introduce corrective actions where the quality of a procurement source is not acceptable according to the overall quality assurance requirements applied by the CPPA.

For inspections at the manufacturer on a procurement lot – if at all feasible - the CPPA’s Quality Procedures for source inspection and pre-cap inspection shall be used.

7 PROCUREMENT

The procurement phase extends from placement of purchase orders to the manufacturers up to completion of the incoming inspections at the CPPA.

7.1 Management Tasks

On authorisation of the prime contractor(s) and/or the DLR the procurement phase starts with issuing the purchase orders for all parts.

7.1.1 Pre-ordering Activities

7.1.1.1 Ordering Sequence

Each of the components identified for the <PROJECT> procurement will be allocated to a one of the following procurement blocks:

- Manufacturers lead time > 24 weeks Block A: Long Lead Items (LLI)
- Manufacturers lead time 13 –24 weeks Block B
- Manufacturers lead time < 12 weeks Block C

The lead times are a result of past experience and are often longer than the delivery times quoted by the manufacturers. In addition to the manufacturers lead times additional time has to be allocated for the CPPA's activities. Typically 6 weeks prior to ordering and 5 weeks after delivery by the manufacturer have to be foreseen.

The users will be given freeze and cut-off dates (see definition in section 3) for each block which define the latest allowable date for placing a purchase order for the respective parts and still obtain the part in due time. Failure to place the purchase order in time causes delay for the schedule of the whole project, as all users orders are needed before placing the collective purchase order with the manufacturer to get the best commercial conditions.

7.1.1.2 Request for Quotation (RFQ) to the Manufacturers

The CPPA will collect the user need and attrition quantities. Upon receipt of a formal negotiation (freezing) for parts lists or individual parts by the respective user(s), the CPPA will submit a Request for Quotation (RFQ) to the concerned manufacturer or authorised distributor, who shall provide the ordering conditions and a time schedule for the production, screening, testing and delivery of the parts to the CPPA.

Further, the RFQ shall also require the manufacturer to define what documentation and data will be delivered with the parts and, if there are any options for selection, any extra charges associated with such data options.

Finally, if the space application suitability assessment requires any screening or testing to establish the final acceptability of the parts, the manufacturer will be asked whether or not he can perform this and if so, what the corresponding charges would be.

7.1.1.3 Evaluation of Quotation and Issuing to Users and the prime contractor(s)

The quotations will be reviewed versus technical and quality requirements, as defined in the PAD. If all items are covered correctly the quotation will be issued to the users and the prime contractor(s) and/or the DLR. Due to the contractual relationship for purchasing parts, the vendor non-recurring costs will be invoiced to the prime contractor(s) and/or the DLR, while the recurring costs are invoiced to the user(s).

7.1.1.4 Negotiation with the Manufacturer

The CPPA will negotiate the most favourable commercial conditions (prices, delivery dates) with the parts manufacturer.

7.1.1.5 Users' Purchase Orders

The Users' purchase orders shall be placed before the cut-off dates as considered and agreed during the first PPCB meetings.

All users' purchase orders shall be placed with the CPPA.

Should a user place a purchase order after the confirmed cut-off dates, he shall be responsible for any cost impact associated with the relevant purchase order.

Should a user modify his parts list and therefore modify his purchase order after the confirmed cut-off dates, he shall be responsible for any cost impact associated to the relevant purchase order.

On request of the user in concern the subject can be discussed during the succeeding PPCB meeting.

7.1.2 Parts Ordering

7.1.2.1 Release of Purchase Orders and Issuing to Manufacturers or Distributors

On receipt of a go-ahead from both, the user and the prime contractor(s) and/or the DLR and pending the availability of the users' formal purchase order(s) at the CPPA, a common purchase order will be established for the manufacturer.

This purchase order will be reviewed by the CPPA project manger or appointed responsible for correctness and proper implementation of specific <PROJECT> project requirements, PAD compliance and commercial delivery conditions and then sent to the manufacturer or his authorised distributor. Appropriate status reporting will be given to the prime contractor(s) and/or the DLR.

7.1.2.2 Acknowledgement of Purchase Orders by Manufacturers or Distributors

In the event of a manufacturer having exceptions to the procurement documents or specification after placement/acceptance of the purchase order, the CPPA will ask for full details of the exception, any cost/schedule impact and/or quality implications. This information will be distributed to the prime contractor(s) and the DLR and, if related to part performance, to the users to assess the effect of the requested exception/deviation and allow for making a final decision on the problem.

When the requested exception is intended to be implemented as a permanent specification change, then CPPA will raise a document change notice (DCN) or invoke the ESA/SCC DCR procedure in case a released ESA /SCC specification requires modification or correction.

7.1.3 Manufacturer Surveillance and Schedule Control

CPPA will maintain the manufacturer surveillance and control throughout the procurement program to ensure that the manufacturer meets the obligations of the purchase order and procurement specification or a set of procurement documents prepared for commercial parts. All major inspection points will be identified within the PAD.

Together with the confirmation of the purchase order, the manufacturer shall submit a milestone plan indicating at least the following schedule dates:

- Pre cap visual inspection (if applicable or feasible)
- Completion of Burn-in and Screening / Final acceptance measurements (if applicable)
- Expected Shipping date of parts to the CPPA

The surveillance of these milestones will be performed by e-mail or fax and telephone communications and by visits, e.g. during pre-cap visual inspections, acceptance test or buy-off, ... etc., if and as applicable.

Based on the actual user need dates schedule surveillance for receiving inspection and shipment of parts to users will be performed by the CPPA.

7.1.4 Data Handling

All the documentation and data used will be processed according to established CPPA procedures and will be filed at the CPPA premises. The data will be made available for the prime contractor(s) and/or DLR and to the users, at least on request.

Each week procurement information will be provided in the data exchange system to the prime contractor(s) and/or the DLR. In addition also the users, who will have access to the internet reporting, can review their list of items being procured with all necessary information for procurement status (lead times, purchase order dates, cut-off dates, etc.).

7.1.5 Reporting/ Documentation

7.1.5.1 Documentation supplied by the Parts Manufacturer

The following documentation will be required from a manufacturer as a minimum for all delivered parts and when ordered in the purchase order:

Commercial parts:

- Certificate of Conformance (CoC) stating that all requirements of the purchase order are met
- Any other information / data as required in the purchase order for e.g. extra screening and/or testing (based on the manufacturer's quotation)

Standard space level parts:

- Certificate of Conformance (CoC) stating that all requirements of the purchase order are met
- Screening or testing attributes summary data
- Variables data and delta calculations (if applicable) related to individual serial numbers
- Copies of the X-ray and SEM photos (if applicable)
- Copies of pre-cap CSI and Acceptance inspection report (if applicable)

7.1.5.2 Reporting Activities during Procurement

The documents/reports to be provided during procurement and to be delivered to the prime contractor(s) and/or the DLR are summarised in the following Table:

	prime contractor(s) and/or DLR			USER
DOCUMENT	A	R	I	
Cut-off dates		x		x
Procurement Progress Report		x		
Consolidated parts list – MPL updates		x		EMPL
CPPA Purchase Order List		x		x
Expenditure Status		x		
DPA Reports		x		
DPA Status Report		x		
Non-conformance reports	(1)	x		x
Non-conformance Status List		x		
Failure Analysis Reports	x			x
Request for Waivers	x			
Radiation Verification Report		x		x
Alerts/Problem Notification	x			x

Notes:

A = Approval R = Review I = Information (1) depending on classification

7.2 Parts Engineering Tasks

7.2.1 Manufacturing and Testing

During manufacture and tests, the performance of the vendors against the established milestones (e.g. Pre-cap, Final tests, etc.) will be monitored by the CPPA engineering.

In addition technical expertise will be provided to solve parts problems. Waiver requests will be reviewed and approved or rejected as applicable.

7.2.2 Parts Screening

In case of parts delivery problems (e.g. for back-up planning), the CPPA will be able to either subcontract screening to an approved test house or to perform the screening at their own facilities. Parts screening tests will only be performed by experienced parts laboratory personnel.

7.2.3 Preparation of Test Procedures

For part types not yet procured by the CPPA, the missing test procedures for the incoming inspection department will be prepared, or when specification changes become necessary, the specifications to be tested against will be reviewed accordingly.

7.2.4 Radiation Verification Testing

7.2.4.1 Radiation Test Plan

For parts that are selected to pass a radiation verification test (RVT), an appropriate test plan shall be established that specifies the test conditions, number of test samples and test steps, ... etc.

As a minimum this test plan will include:

- device type, part designation, manufacturer, reference of procurement specification
- date code, wafer lot no., wafer no. as applicable

- total dose test level and steps (see para.6.2.1.2)
- annealing steps and conditions (ESA/SCC22900)
- device parameters to be measured (according to conditions and limits specified in the data sheet or detail specification)
- bias condition and circuit during Irradiation and Annealing
- documentation requirements

7.2.4.2 Radiation Testing

If the radiation verification testing is performed by the manufacturer and the radiation testing planned is not part of the radiation hardness verification testing as per an applicable MIL specification, the approved test plan has to be issued together with the purchase order to the manufacturer who shall confirm concurrence to the test plan.

If the radiation test is not performed by the manufacturer, it will be conducted by or at least under the responsibility and supervision of the CPPA.

When commercial devices shall be submitted to RVT tests, the special traceability requirements per section 5.5.1 shall be observed.

7.2.4.3 Radiation Verification Test Report

The results of the radiation verification testing will be presented in a radiation verification test report. This test report shall include as a minimum:

- scope and objectives
- summary of test results
- evaluation of test results, emphasising significant events and problems encountered
- interpretation and correlation of test results to relevant analytical predictions as relevant
- a list of all non-conformances generated during the test (including NCRs)
- the as run test procedure including a list of deviations from the applicable test procedure
- continuous test monitoring records if and as applicable

7.3 Quality Assurance Tasks

7.3.1 Source Inspection

7.3.1.1 Pre-cap Customer Source Inspection / Tests

Pre-cap CSI is not possible for commercial parts. The same is also valid for many part types procured from US suppliers with QML certification/approval. As a result, conformance to the visual inspection, bond pull and die shear test requirements shall be checked by the CPPA during DPA which may require a larger number of DPA samples. This shall be defined on the PADs accordingly.

For standard space level parts (primarily from European suppliers), however, pre-cap CSI may still be possible and thus, it may be envisaged for critical part types while for qualified part types the inspection shall be carried out by the manufacturer's QA personnel.

If required in the PAD, the CPPA or an authorised representative will perform a pre-cap visual inspection at the manufacturing or assembly facility in accordance with the applicable specification and to the requirements defined in the CPPA's in-house procedures for pre-cap CSI.

Pre-cap CSI might be considered for the following part categories:

- Integrated circuits including hybrids
- Transistors
- Relays
- Diodes (with cavity packages only)
- Quartz crystals
- Coax- and wave-guide switches and isolators
- Resistor networks
- Opto components

Furthermore, during the visit for the pre-cap visual inspection a bond pull and die shear test, (if applicable), will be performed on 3 samples (2 pcs if more than 8 wires/part) from the inspected lot, which can be visual rejects if no obvious influence on the bond pull and die shear strength exists. The results of these tests will also be recorded in the pre-cap visual inspection report.

The prime contractor(s) and/or the DLR or the designated representative will have the right to participate in the source inspection.

7.3.1.2 Final Source Inspection / Acceptance Test or Buy-off

Final CSI, acceptance testing or buy-off shall be envisaged for critical part types only and as deemed necessary on a case by case basis which shall be indicated on the PADs. For commercial part types, however, such inspection/testing will not be possible.

This inspection and test may also be used as a substitute for receiving inspection in those cases where the required electrical / optical testing cannot be carried out at the CPPA's premises due to lack of suitable (automatic) test equipment, test adapters or test program / software.

If required in the PAD, a final source inspection or buy-off of the delivery lot will be conducted prior to shipment, to assure conformance with the requirements of the purchase orders, procurement specification and data requirements.

The prime contractor(s) and/or the DLR or the appointed representative will have the right to participate in the source inspection.

7.3.2 Non-Conformances or Failures

7.3.2.1 Non-Conformance Control

Non-conformances occurring during parts procurement will be classified as minor or major based on the CPPA's NCR procedure.

A **minor** non conformance is a minor defect of a part that is not likely to reduce materially the usability of the part for its intended or specified application, like:

- random failures where no risk for a lot related or reliability problem exists and where the affected parts can probably be reworked or used as is;
- deviations from the procurement requirements, where form, fit or function of the part is not affected;
- negligible inconsistencies in the manufacturer's deliverable documentation as applicable.

A **major** non conformance is a major defect of a part that is likely to result in an unsafe condition or to reduce materially the usability or reliability of the part or the whole lot for its intended or specified application, like:

- failures detected during any inspection or test which affect the form, fit or function;

- failure which are related to an inability to comply with the requirements as defined in the applicable procurement documents or specifications, in terms of form, fit or function and reliability;
- missing of required documentation

Major NCRs will be supplied to the prime contractor(s) and/or the DLR. Minor NCRs will be available at the CPPA for review.

The status of all NCRs will be reported on a regular periodic basis, e.g. during PPCB meetings.

7.3.3 Problem Notification/ Alerts

For traditional space level parts the CPPA will operate a Problem Notification/Alert System in accordance with the general requirements in ECSS-Q-60A and ECSS-Q-20-09A, which will be used to identify or address parts problems, which may affect any user, such as individual technologies, specific manufacturers, ... etc.. It will not resemble a replacement for the NCR-system, but will be taken as a means to distribute important information independent of projects to all "points of interest", who may be affected by the reported problem.

Note: **commercial part types** so far have not been covered by such a system and thus, any such information relevant to commercial parts will be distributed to the parties involved in the <PROJECT> programme only.

If an official alert is issued about the problem it will amend/supersede the problem notification.

Inputs to the system can come from a variety of sources, including, other national space agencies, manufacturers, customers and other companies involved in EEE parts procurement activities.

If a problem/alert is known, the notification will be given to the prime contractor(s) and/or the DLR without delay.

Any problem notification/alert issued during procurement will of course be reviewed and investigated by the CPPA to support the <PROJECT> programme in the evaluation of the problem, if applicable.

If a part used within the <PROJECT> project is affected, a corresponding NCR has to be established.

7.3.4 Parts Shipment from Manufacturer to CPPA

For commercial parts typically bulk packaging is used for the shipment of parts to the purchaser, while for standard space level parts individual packaging may be used in line with the procurement specification requirements.

Never-the-less, all parts shall not suffer changes in any characteristics or loss of inherent reliability during shipment and storage. Parts which are sensitive to electrostatic discharge shall be packaged in such a manner that they cannot be damaged by a discharge and the bulk or individual packages shall bear an appropriate ESD warning label.

7.3.5 Incoming Inspection

7.3.5.1 Receipt of Parts

On each parts delivery the CPPA will perform receiving inspection consisting of a check for transportation damage, a parts count and a detailed inspection as defined in the CPPA's in-house procedures for the incoming inspection.

The extent of the incoming inspection applied will depend on the experience gained by the CPPA with the corresponding manufacturer.

The incoming inspection shall cover the following:

- Visual Inspection on **100%** basis for commercial parts and **10%** for standard space level parts; in case of one failure, a 100% inspection will be performed
- Check-of Dimensions (Mechanical Inspection):

  The critical dimensions will be checked on 3 pieces. In case of a failure a 100% check of the dimensions concerned will be performed.
- Electrical Measurements

  The electrical measurements will be on **10%** basis on critical parameters, if final source inspection has not been carried out. In case of failure 100% of the parts shall be measured.
- Destructive Physical Analysis

  DPA shall be carried out as detailed below and if defined on the PAD.
- Review of delivered Manufacturer Documentation, if and as applicable.

7.3.5.2 Destructive Physical Analysis

DPA will be performed on commercial and non-standard parts in accordance with CPPA's in-house procedures on samples from each date code of the part types listed below:

- discrete semiconductors
- integrated circuits
- filters
- ceramic capacitors
- wet tantalum capacitors
- relays
- crystals
- hybrids
- switches
- high-voltage components
- high-frequency components
- opto-electronic components
- parts employing new technologies

DPA shall not be required for qualified standard space level part types covered by the ESA/SCC QPL / QML and the US MIL QPLs / QMLs.

Standard DPA sample size shall be:

- 3 pcs per delivery lot in case the delivery lot size is > 100 units, else 2 units;

Exceptions from the above rule are recommended on a case by case basis for:

- hybrid (multi-chip) devices
- high cost parts

The sample size for DPA on passive parts not mentioned above will be accommodated to the number of different values and discussed with the prime contractor(s) and/or the DLR case by case. For a family or a range of components (ICs, resistors, capacitors, etc.) a selection in terms of date-code or function similarity will be proposed.

The results of the DPA will be recorded in a separate report which will be available for review at the CPPA premises.

7.3.5.3 Data Review of the Manufacturer Documentation

The CPPA will review any manufacturer documentation delivered with the parts as required by the purchase order to ensure that

- all parts delivered are within the specified limits
- the manufacturer has carried out all tests as required in the procurement documents or specification
- all PDA criteria if and as applicable have been met and
- the receiving inspection results are consistent with the manufacturer's data.

Note: for commercial parts the delivered data may be confined to a CoC only.

7.3.6 Issuing of a Certificate of Compliance (CoC)

After successful completion of all incoming inspection tasks a certificate of compliance (CoC) will be prepared by the CPPA and enclosed with the parts shipment(s) to the users.

7.3.7 Handling and Storage of Parts

All parts will be handled and stored at the CPPA premises under the following conditions in accordance with ECSS-Q-60A and as detailed in the applicable CPPA in-house procedure:

- Storage areas are controlled for temperature, humidity and cleanliness.
- During receiving inspection parts are segregated from other items and protected against degradation.
- Measures will be implemented to ensure that ESD sensitive parts are identified, protected, handled and stored by properly trained personnel.

The transport of parts outside of controlled rooms will only be performed in clean and dust-tight conductive containers.

For each lot in store a specific file – the documentation - will be compiled, including:

- all documents supplied with the lot
- inspection and verification reports
- DPA reports
- all documented and closed out non-conformances
- the CoC

8 POST-PROCUREMENT

The post-procurement phase extends from shipment of parts to the users to the end of the contract.

8.1 Management Tasks

8.1.1 Administration and Data Handling

The CPPA will:

- release shipments
- manage dispatching of parts to the users
- update parts procurement lists
- prepare of all documentation / paper sets to be delivered to the users if applicable
- send copies of DPA reports to the prime contractor(s) and/or the DLR if so requested
- control the non-conformances and NRB activities and their proper close-out status
- organise user participation in the completion of activities resulting from parts failures after delivery to the users (failure analysis, recommendation, re-procurements, etc.) and will report to the prime contractor(s) and/or the DLR
- carry out general administration and reporting of all on-going activities
- carry out updating of the master schedule as relevant due to non-delivered order quantities, replacement parts, ... etc.
- final price updating

The deliverable data to the prime contractor(s) and/or the DLR are summarised in subsequent table:

	prime contractor(s) and/or DLR			USER
DOCUMENT	A	R	I	
Progress report		x		
Consolidated Parts List - MPL updates		x		x (EMPL)
CPPA Purchase Order List updates / schedule		x		x
Shipping List		x		x
Expenditure Status		x		
DPA reports		(x)		(x)
DPA status list		x		
Non-conformance reports	x			x
Failure Analysis Reports		(x)		x
Non-conformance status list	x			
Experience summary report		x		

Notes: A = approval; R = Review; I = Information; (x) = as applicable

8.1.2 Parts Shipment and Shipment Notification

On successful completion of receiving inspection (or acceptance inspection/buy-off - as applicable) and after authorisation from the prime contractor(s) and/or DLR, the following will be shipped from the CPPA to the user as required:

- Quantity of the ordered parts (including attrition)
- Certificate of Compliance issued by the CPPA confirming that receiving inspection, data review and DPA has been carried out and the parts can be released for flight application
- A copy of any NCR.
- Invoice for Recurring Costs

All invoices will be issued by the CPPA.

The following documentation will be held at the CPPA and shipped to the users only on request of the prime contractor(s) and/or the DLR:

- One copy of the manufacturers data package (e.g. when variable data are needed by a user)
- DPA report
- Results of the receiving inspection including Data Pack Review

The user will be notified by fax or e-mail about the shipment with indication of part type(s) and quantity(ies), flight- and airway bill number (AWB), date and time of anticipated arrival in the designated territory at the "point of entry" as indicated by the user (e.g. airport and airfreight agent) in accordance with CIP Incoterms 1990. The prime contractor(s) and/or the DLR will be notified about the shipment within 2 working days.

Accordingly, the cost and responsibility for the appointed airfreight agents rest with the user.

The users will be requested to confirm receipt of the parts from their airfreight agents within 5 working days by fax/e-mail.

Any problem identified on parts by the user shall be notified to the CPPA without delay by fax or e-mail, but no later than 30 days after receipt of the parts.

8.1.3 Experience Summary Report

The CPPA project manager will prepare and issue a report to the prime contractor(s) and/or the DLR summarising the CPPA activities with respect to the <PROJECT> programme. Details to be addressed shall meet those required in the SOW, DRD-33 [A1].

Special emphasis shall be put on the experience gained with the procurement of commercial parts. It shall present a comparison of the overall efforts necessary for procuring commercial parts to those required for standard space level parts. In addition, the CPPA shall estimate, how many project procurement iterations would be required to achieve the optimum cost savings as expected from the use of commercial parts in space applications.

The summary report shall be supplemented by a stock list of parts remaining at the CPPA premises to allow for the control of DLR property.

8.2 Parts Engineering Tasks

Parts engineers will provide technical expertise in all areas necessary. The main effort during this phase will be directed towards non-conformances, material review boards and failure analysis.

8.2.1 Component Failure and Failure Analysis

Any failure occurred during procurement and delivery, must be notified to the prime contractor(s) and/or the DLR according to the major non-conformance processing.

A failure analysis will be performed according to MRB disposition.

Parts identified as failed will be analysed to determine the cause and the influence on the remaining lot and the consequences on the interfaced parts. The tests and test sequence will be adapted on the individual situation and the failed component type. The failure analysis will include, when applicable, electrical testing, SEM inspection, photographs after sectioning and/or metallurgical examination.

As soon as the parts have been accepted by the users, the relevant users are responsible for any failure occurring and any failure analysis. If requested by the prime contractor(s) and/or the DLR support will be given by the CPPA.

The test results and findings will be reported in a failure analysis report (FAR), which will be provided to the prime contractor(s), the DLR and any affected users.

8.3 Quality Assurance Tasks

8.3.1 Parts Shipment from CPPA to the User(s)

On successful completion of the receiving inspection, which includes data review and DPA ,if applicable, the receiving inspection folder will be forwarded to QA for review and final release of flight parts. After QA sign off the parts will be transferred to the Hi-Rel stores and prepared for shipment to the user(s). Appropriate indications will be given to the parts engineering group which is taking care that all necessary paperwork is prepared and sent along with the parts to the user(s). Notification of shipment will be given to the prime contractor(s) and/or the DLR to obtain authorisation for shipment(s).

All destructive test samples (CA, DPA, RVT, ... etc.) and overrun parts from Minimum Order Quantities will be kept at the CPPA stores up to TBD years unless otherwise directed by or contractually defined by the prime contractor(s) and/or the DLR.

9 STATEMENT OF COMPLIANCE

9.1 Compliance Matrix to CPPA-SOW

The following compliance statements are given to the Statement of Work (SOW) – see [A1] – in a sequence following the paragraphs of the original document. Comments to the compliance statement are provided as necessary.

Paragraph	Title / Description	CoC	Comment
All	As per the SOW	C	-

Appendix 1:

PAD SHEET

PARTS APPROVAL DOCUMENT

Deutsches Zentrum für Luft- und Raumfahrt e.V. in der Helmholtz-Gemeinschaft

Project: Sheet 1 of ... Doc. No.: Issue Date:

PROCUREMENT REQUIREMENTS SHEET

APPROVAL requested by CPPA

Family: Fcode: Group: Gcode:

Component Number: Similar to Style:

Technology/Characteristics (range, case, tolerance, voltage etc Value:

Generic Specification: Issue Rev:

Generic Amendment: Issue Rev:

Detail Specification: Issue Rev:

Detail Amendment: Issue Rev:

Manufacturer: Location/Country:

Back-up Manufacturer: Location/Country:

PROCUREMENT REQUIREMENTS

1. LEVEL
- ☐ Commercial
- ☐ Military
  - ☐ ERMIL
  - ☐ JAN
  - ☐ JANTXV / CLASS B / QML-Q
  - ☐ JANS / CLASS S / QML-V
  - ☐ . . . . . .
- ☐ ESCC

2. SCREENING
- ☐ No screening
- ☐ Burn-in . . . . . .
- ☐ Other . . . . . .
- ☐ According to MIL
- ☐ According to ESCC

3. INSPECTIONS:
- ☐ SEM
- ☐ Pre-cap ☐ Manufacturer ☐ Orderer
- ☐ X-ray
- ☐ PIND
- ☐ Acceptance
- ☐ DPA Sample size: . . . . . .
- ☐ Other . . . . . .

4. LOT ACCEPTANCE TESTING
- ☐ None
- ☐ Life testing
- ☐ Mechanical testing
- ☐ Environmental testing
- ☐ Other
- ☐ Groups . . . . . according to MIL . . . . . .
- ☐ LAT . . . . . according to ESCC

5. RADIATION ACCEPTANCE TESTING ON FLIGHT PARTS

TOTAL DOSE ☐

Cobalt 60 ☐

RVT Plan . . . . . .

Protons

RVT Plan . . . . . ☐

APPLICATION ENVIRONMENT REQUIREMENTS

The Part is compatible with the application environment ☐

The Part has to be limited in it's application ☐

PROCUREMENT JUSTIFICATION

☐ PPL ☐

☐ Assessment Summary Sheet 1 ☐ Assessment Summary Sheet 2 ☐ Assessment Summary Sheet 3

Approval CPPA Date:

Approval Parts Review Board Date:

Approval Customer Date:

Appendix 2:

ASSESSMENT SUMMARY SHEETS

SHEET 1: ASSESSMENT FOR GENERAL USE IN SPACE APPLICATION
SHEET 2: ASSESSMENT FOR SPECIFIC PROJECT USE
SHEET 3: DETAILED DESCRIPTION OF RISK CONTROL MEASURES

Assessment Summary Sheet 1 of 3

ASSESSMENT FOR GENERAL USE IN SPACE APPLICATIONS

Part Type		Part No.	
Manufacturer		Package / Case Size	
Variant / Revision		Reference Date	
Limitations			

Key Ele. No.	Key Element Description	Result (direct assessment)	Result (indirect assessment)	Risk control measures	Overall result
1	Thermal				
2	Mechanical				
3	Construction				
4	Radiation				
5	Process Control				
6	Rel. Ass. System				
7	Reliability Data				
8	Final El. Test				
9	AOQL				
10	Quality System				
11	Traceability				
12	Specification				
13	Delivery Time				

Legend: √ = Acceptable for general use; NO = Not Acceptable; ? = Insufficient Info/Data; N/A = not applicable

Final Disposition: The ref. part type is

☐ acceptable for general space use

☐ This assessment result is only valid for procurement with the risk control measures indicated.

☐ NOT ACCEPTABLE FOR SPACE USE !!!

ORGANISATION			
Name			
Date			

Assessment Summary Sheet 2 of 3

ASSESSMENT FOR SPECIFIC PROJECT USE **PROJECT:**_____

Part Type		Part No.	
Manufacturer		Package / Case Size	
Variant / Revision		Reference Date	
Limitations			

Key Ele. No.	Key Element Description	Result (direct assessment)	Result (indirect assessment)	Risk control measures	Result after risk analysis	Overall result
1	Thermal					
2	Mechanical					
3	Construction					
4	Radiation					
5	Process Control					
6	Rel. Ass. System					
7	Reliability Data					
8	Final El. Test					
9	AOQL					
10	Quality System					
11	Traceability					
12	Specification					
13	Delivery Time					

Legend: √ = Acceptable for general use; NO = Not Acceptable; ? = Insufficient Info/Data; N/A = not applicable

Final Disposition: The ref. part type is

☐ acceptable for specific project use Project:

☐ This assessment result is only valid for procurement with the risk control measures indicated.

☐ NOT ACCEPTABLE FOR USE IN THE PROJECT !!!

ORGANISATION			
Name			
Date			

Assessment Summary Sheet 3 of 3

Detailed description of risk control measures

No.	Risk control measures	Detailed description
1		
2		
3		
4		
5		

Notes:

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