

Chapter 10 : Standard schedule, deliveries and documentation

CHANGE TRACEABILITY Chapter 10

Here below are listed the changes between issue N-2 and issue N-1:

N°§	PUID	Change Status	Reason of Change	Change Reference	Doc Issue
§10.3.5		Modified in	Star Tracker Assembly	CIIS.4.1.JC.1_14	6.2
§10.3.6.1	[PL - 10.3.6 -1 a]	Modified in	Connectors provided by ALCATEL	CIIS.4.1.JC.2_3	6.2
§10.3.6.2		Modified in	Wiring provided by ALCATEL	PUM.6.1.CG.31_31	6.2
§10.3.6.2	[PL - 10.3.6 -2 a]	Modified in	Connectors provided by Payload	CIIS.4.1.JC.2_3	6.2

Here below are listed the changes from the previous issue N-1:

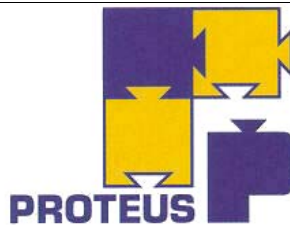
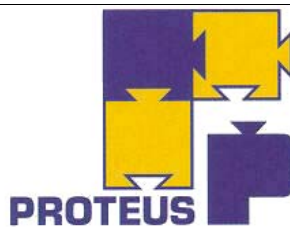


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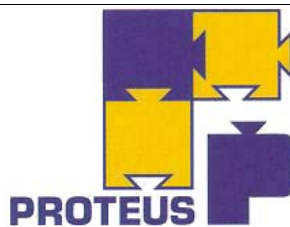
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LIST OF TBCs

LIST OF TBDs



Chapter 10: Standard schedule, deliveries and documentation

10.1 PROTEUS STANDARD SCHEDULE (PRELIMINARY)

The generic schedule corresponding to the PROTEUS standard services is presented Figure 10.1-1.

This schedule is built with the following hypothesis :

- the satellite is based on a standard platform; the platform adaptations are limited to minor changes so called «missionisation».
- ALCATEL SPACE and CNES lead activities on platform and satellite engineering, integration and tests.
- The generic ground control segment is procured including one ground station and one control centre.
- A single interface is considered between the mission centre and the control centre located in Toulouse.
- PROTEUS standard services include the transportation, the launch campaign activities, flight acceptance & first operations and the control centre operations too.
- Pre-Phase B and phase B durations are indicative. They shall be adapted to cope with payload development.

Notice : BV is validation bench and may be adapted either in numerical validation bench or in system functional validation bench ; it is defined in the paragraph 10.1.3.

Note that the satellite is based on an existing platform and consequently the schedule critical path is more likely through the payload development. Thus, payload works have to start firstly, but some satellite studies must begin as well, at the beginning of the payload development, in order to ensure a global technical consistency and provide payload with updated interface and environmental specifications.

The logigram shown in Figure 10.1-2 describes the general logic regarding the satellite segment level and the 3 main system levels which are Payload, Platform and Satellite On Board SoftWare.

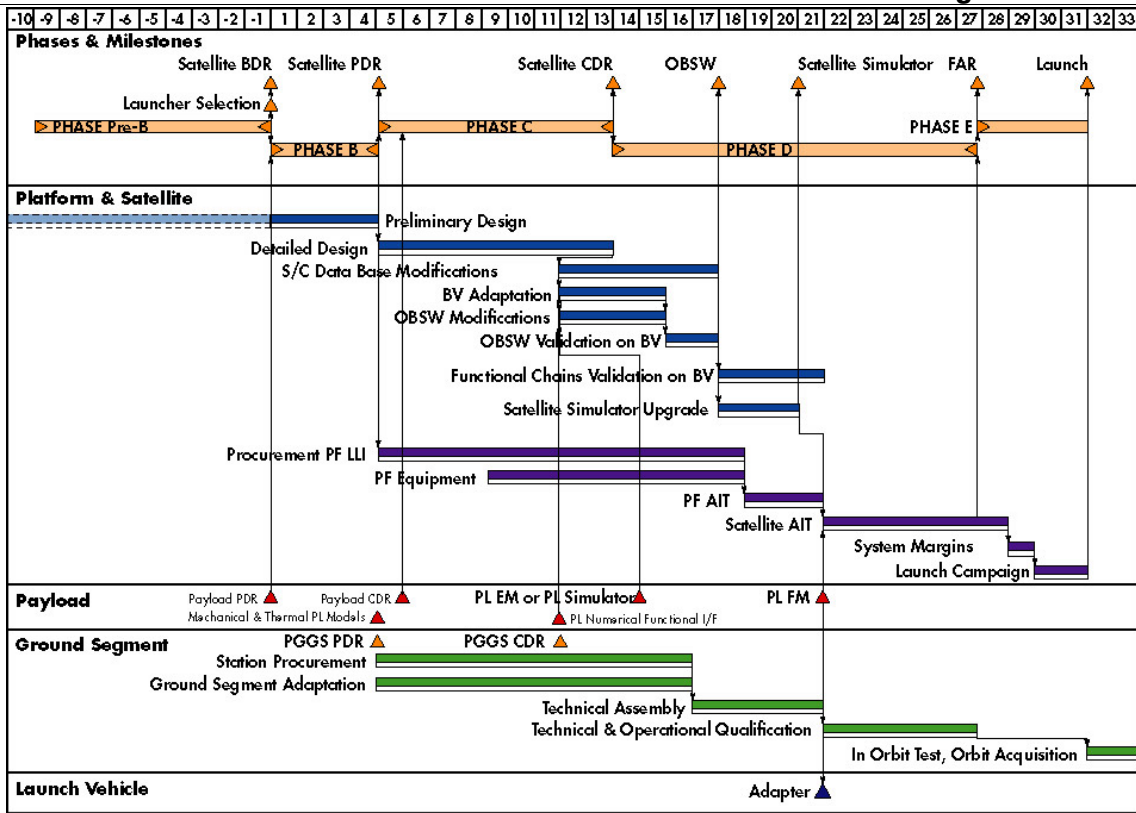


Figure 10.1-1 : PROTEUS standard schedule

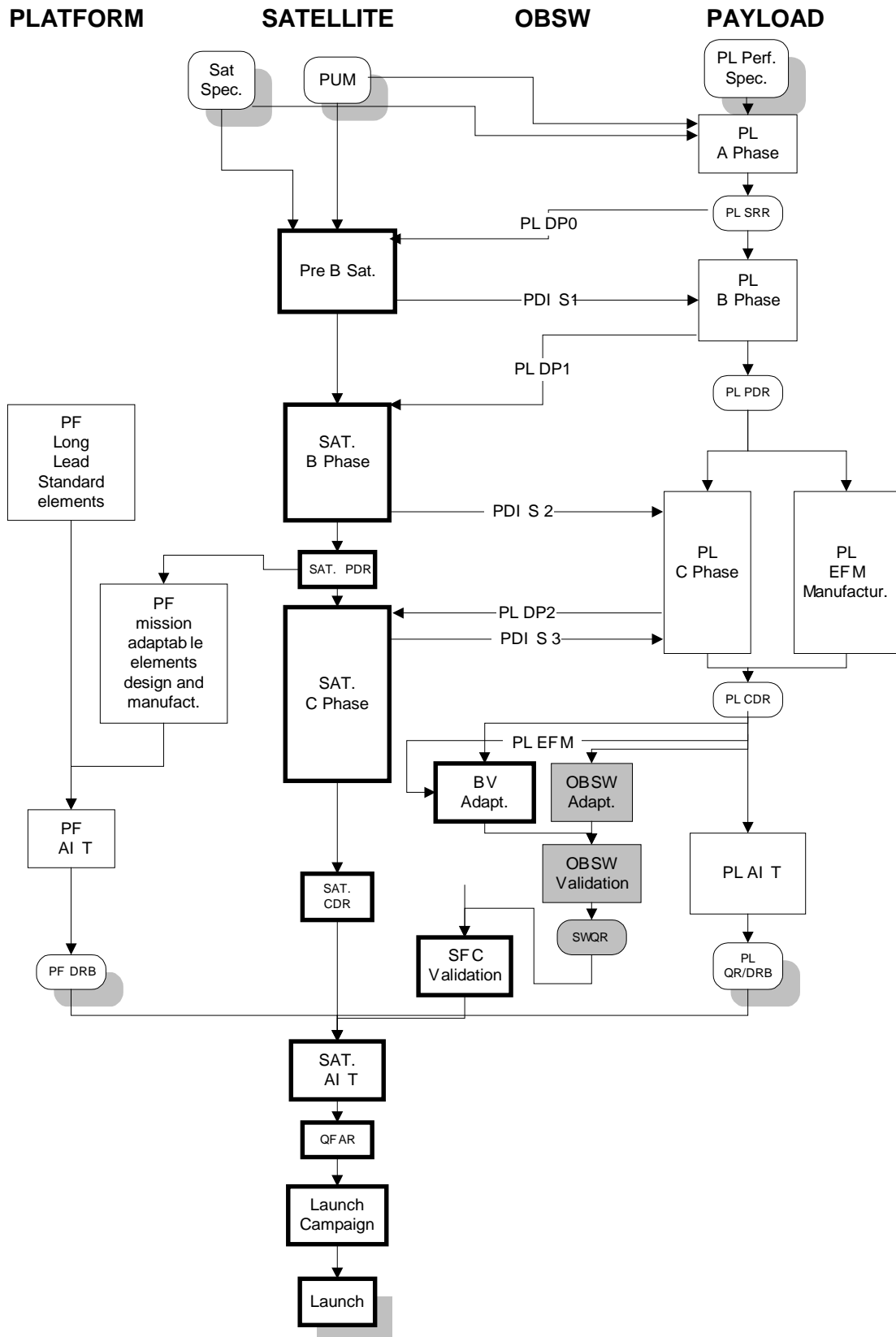
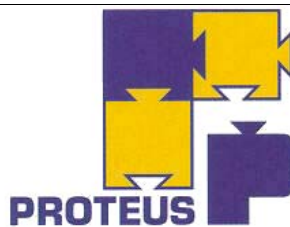


Figure 10.1-2 : PROTEUS development logic



The satellite schedule is divided in five main phases : Pre-phase B, phase B, phase C (duration of 9 months), phase D (14 months) and phase E. Hereafter are described the main activities and objectives for each satellite phase. These essential points shall be fulfilled to maintain the schedule.

10.1.1 PROTEUS PRE-PHASE B

The purpose of this phase is to confirm that the mission belongs to the PROTEUS flight domain (feasibility study) and to provide the payload with specific inputs to complete the generic ones which are described in the PROTEUS User's Manual (PUM). In order to achieve this goal, the necessary inputs, required at the beginning of this phase, are :

- a first issue of Satellite Specification
- a first issue of Mission Specification
- a first Payload Data Package (DP 0) containing at least :
 - an issue of Payload Interfaces Requirements Descriptions or Instruments Interfaces Requirements Descriptions (if the payload is composed of several independent instruments and managed separately)
 - Payload mathematical models
 - A simplified CAD model
 - A simplified Finite Element Model
 - Payload budgets

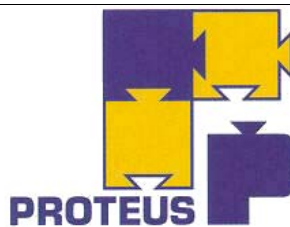
At the beginning, ALCATEL SPACE reads and comments the Satellite Specification, as well as the activities led by the Customer during the payload phase A. Then, the feasibility studies (depending on the satellite specific points) are performed and end at a Baseline Design Review (BDR) with :

- A preliminary concept of the satellite,
- An identification of points out of PROTEUS flight domain,
- An identification of critical points,
- A confirmation of schedule aspects.
- A first issue of Payload Design and Interface Specification (PDIS)

The Customer ensured the follow up of payload phases A and B. The input data provided by the platform for these first payload feasibility and design phases are :

- the PROTEUS User's Manual
- the standard Star Trackers Assembly Finite Element Model (this standard STA can be modified if imposed by mission constraints; in this case, a new FEM will be provided at the beginning of payload phase C)

The PUM is replaced by the PDIS at the end of this pre-phase B. During this phase, the customer still ensures the payload follow up. As an option, ALCATEL SPACE could participate to the payload meetings if ALCATEL SPACE is in charge of the payload follow up for the next phases.



10.1.2 PROTEUS PHASE B

Phase B starting defines the T0.

The platform equipment are ordered during this phase and the long lead Items procurement starts immediately after T0. Some agreements between Alcatel Space and the concerned suppliers permit to get these items on time, that means for platform assembly.

The objectives consist in establishing a satellite preliminary definition, in confirming the missionisation activities (platform harness, system data base, software updates and so on) to lead in phase C and also to provide the payload with accurate data for its detailed definition phase.

In order to manage the phase B tight schedule and to obtain results as accurate as possible, the necessary inputs at the beginning of this phase are :

- The launch vehicle choice. This point is very important to make accurate satellite qualification and flight environment requirements.
- Update (if any) of the Satellite and Mission specification
- A new payload Data Package (DP 1) containing at least :
 - A Payload Description Document (synthesis document)
 - A Payload Interface Control Document
 - A set of mathematical models
 - A CAD model
 - Two Finite Element Models (one physical model and one reduced model)
 - Payload budgets
 - A Payload Design, Development and Validation Plan

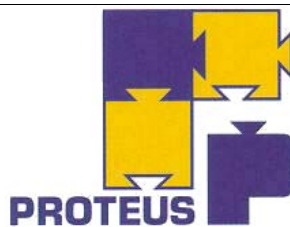
The required documents are described in section 10.2.

Based on these data, the following main activities are performed :

- Preliminary analyses in mechanical, thermal, electrical, Attitude Orbit Control System (AOCS) and command control domains.
- Attitude Orbit Control laws coefficients tuning

The Satellite Preliminary Design Review concludes the phase B and allows to begin the detailed analysis. At the end of this phase:

- The payload interfaces specifications are updated in the PDIS (Payload Design and Interfaces Specifications). As an option, the instruments interfaces specifications are defined too in the IIS (Instruments Interfaces Specifications) and the PDIS is adapted at instrument level if ALCATEL SPACE is responsible for instruments integration in the Payload Instruments Module.
- The ground and launch interfaces are defined too.
- A satellite configuration is defined
- The PL ICD is commented and, if necessary, STA and H02 & H03 new accommodation is proposed.



10.1.3 PROTEUS PHASE C

During this phase, Alcatel Space leads all the activities relating to the missionisation :

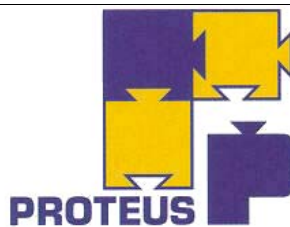
- satellite detailed analysis in mechanical, thermal, electrical, Attitude Orbit Control System (AOCS) and command control domains.
- platform realization files updates
- flight software updates
- satellite data base parameters updates.
- Payload Design and Interfaces Specifications (PDIS) are updated again after detailed analysis.
- Beginning of the adaptation activities for the validation bench BV.
BV permits to validate the flight software; It simulates all the Data handling Unit (DHU) interfaces in opened or closed loop. The simulation in closed loop is possible for the AOCS chain. The flight software for validation is loaded from a computer to the DHU.
BV permits also to validate all the satellite functional chains. It simulates all command/control interfaces of these chains in opened or closed loop. The simulation in closed loop is possible for the AOCS, thermal and electrical chains and the payload.
BV activities requires a payload functional interface model (see section 6.1.2.1).
- Beginning of the software modifications and the system data base update.
- Beginning of the activities for the launch vehicle adapter realization.

Moreover, the first Launch Coupled Analysis is performed.

The necessary inputs are :

- A new payload Data Package (DP 2) containing at least :
 - A Payload Description Document (synthesis document)
 - A Payload Interface Control Document
 - A set of mathematical models
 - A CAD model
 - Two Finite Element Models (one physical model and one reduced model)
 - Payload budgets
 - A Payload Design, Development and Validation Plan
 - A Payload Verification Plan
 - A Payload AIV requirements

The Critical Design Review concludes the phase C; that permits to freeze the design and to start realization.



10.1.4 PROTEUS PHASE D

During this phase, ALCATEL SPACE manages the modifications defined in Phase C. In this phase, the platform equipment units and the long lead items are supplied . Then, ALCATEL SPACE leads the platform Assembly Integration and Tests. And as soon as the payload flight model is received and accepted, ALCATEL SPACE leads the satellite Assembly Integration and Tests.

Notice : The payload shall be entirely qualified before ALCATEL SPACE delivery. At satellite level, only payload health check and acceptance tests are planned.

ALCATEL SPACE delivers to the Customer:

- the satellite numerical models for launch vehicle,
- the system data base,
- the satellite flight model on launch site,
- a « Telemetry Tracking and Command suitcase » is available; it permits to check the compatibility between satellite and ground segment,

A satellite simulator is delivered to the ground segment in order to validate the operational interfaces (optional).

The Authority in charge of the payload delivers to ALCATEL SPACE:

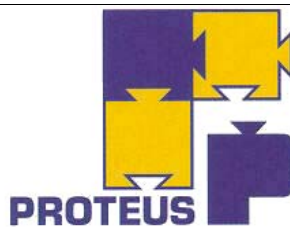
- a payload functional interface model for the validation bench (BV) adaptation, this model shall be fully representative in term of electrical and functional interfaces
- a payload flight model,
- the payload ground support equipment is available, during all satellite activities : from payload delivery to launch.

10.1.5 PROTEUS PHASE E

During this phase, ALCATEL SPACE supports CNES for the launch campaign and the flight acceptance.

In PROTEUS standard, CNES operates the satellite in Toulouse.

The Customer operates the mission center.



10.2 SATELLITE DOCUMENTATION

The documentation relating to the PROTEUS mission can be divided in the main following parts :

- the applicable documents (inputs) and interfaces documents
- the management documents
- the product assurance documents
- the documents describing the development and validation logic
- the system description and performances documents
- the justification documents
- the documentation relating to operations
- the documentation dealing with the mission centre/PROTEUS Generic Ground Segment interfaces

The purpose of this chapter is to list the main documents delivered for each activity quoted above. In the following tables, « Supplier » designates ALCATEL SPACE or CNES.

The publication dates are satellite events dates.

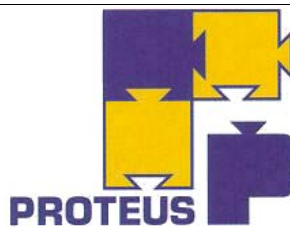
10.2.1 APPLICABLE DOCUMENTS AND INTERFACES DOCUMENTS

10.2.1.1 Satellite and system

Title	Issued by	Publication date	Comments / Purpose
Mission System Requirements	Customer	T0 Pre-phase B T0 phase B	for information
Satellite Specification	Customer or CNES	T0 Pre-phase B T0 phase B T0 phase C	
Satellite to Ground Interfaces	CNES	T0 phase B T0 phase C	this document refers to the standard "PROTEUS Satellite to Ground interfaces"
System Test Requirements	Customer	CDR	
System Test Plan	Customer	CDR	

10.2.1.2 Launch vehicle interfaces

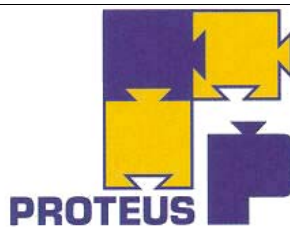
The launch vehicle choice and the launch configuration are definitive at the beginning of phase B (BDR). The main documents exchanged with the launch vehicle authority are listed in the User's Manual of the chosen launch vehicle.

**10.2.1.3 Payload interfaces****PL - 10.2.1 -1**

The payload Supplier shall delivered all the documents mentioned in this Table as issued by the Customer

Title	Issued by	Publication date	Comments / Purpose
PROTEUS User's Manual (PUM)	Supplier	Standard	it gives the interfaces & environment specifications for a payload based on PROTEUS before the first PDIS issue.
Payload Interfaces Requirements Description (PID)	Customer	T0 Pre-phase B	this document describes the payload interfaces
Payload Design and Interfaces Specifications (PDIS)	Supplier	BDR PDR CDR	this document is written from the PUM and PID and is the applicable interface document for the payload
Payload Interfaces Specifications Compliance and Verification Matrix	Customer	CDR and with PL FM delivery	this document allows to check the PL interfaces compliance
Payload CAD models (electronic files)	Customer	T0 Pre-phase B T0 phase B T0 phase C	These inputs are necessary to lead satellite accommodation under the fairing, field of view verification ... These models shall be provided with the associated drawings.
STA mechanical mathematical models (electronic files)	Supplier	Standard PDR	these inputs are necessary to lead payload mechanical analyses. These models will be provided with a description document.
Payload mechanical mathematical models (electronic files)	Customer	T0 Pre-phase B T0 phase B T0 phase C after correlation	these inputs are necessary to lead satellite mechanical analyses. These models shall be provided with a description document.
Payload budgets	Customer	T0 Pre-phase B T0 phase B T0 phase C	Mass properties, power (for each lines and each PL mode), data rates
Payload description document	Customer	T0 phase B T0 phase C	This documents provides a description of the payload and gives at least : <ul style="list-style-type: none"> • Payload and mission overview • Description of each architecture (mechanical, thermal, electrical, command and control) • And other specific features
Payload Interface Control Document (PICD)	Customer	T0 phase B T0 phase C and at every change	PICD is composed of at least <ul style="list-style-type: none"> • Payload Interfaces Data sheet • Grounding scheme • Interfaces Descriptions Drawings • ... (see section 4.1.1)

Some of these documents are more precisely described in the following paragraphs.



10.2.1.3.1 PROTEUS User's Manual (PUM)

PROTEUS User's Manual is a generic document describing more particularly interfaces specifications between PROTEUS Satellite and Payload. This document is a standard document and is available at the beginning of project. It is written for three PROTEUS User groups : System Prime, Mission Center Prime and Payload Prime.

10.2.1.3.2 Payload Design and Interfaces Specification (PDIS)

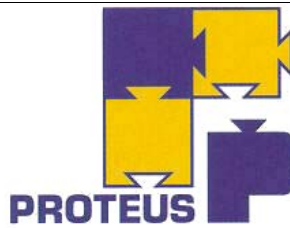
PDIS is a specifying document, particular for each mission. It is a PROTEUS User's Manual specific adaptation and its table of contents is the same as the PUM one. PUM is a reference document for PDIS. Adaptations to the generic specifications, if needed for the mission, are described in PDIS.

It deals with interfaces constraints imposed by the Satellite Prime to the Payload Prime. Specifications result from Platform, satellite and system levels.

This document is updated in each design phase thanks to payload data packages and satellite level analyses.

10.2.1.3.3 Payload Interface Control Document (PICD)

Payload Prime describes payload interfaces in PICD. PICD is the answer to the PDIS, that is to say that for each PDIS issue, there is a PICD issue.

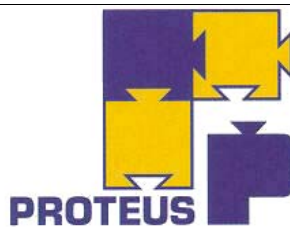


10.2.2 MANAGEMENT DOCUMENTS

Title	Issued by	Publication date	Comments / Purpose
Management plan	Supplier	PDR	
Review reports	Supplier	PDR CDR FAR	At each review, a report is published
Schedule report	Supplier	PDR, each 6 weeks	
Payload Deliverable Items list	Supplier	PDR, CDR	

10.2.3 PRODUCT ASSURANCE DOCUMENTS

Title	Issued by	Publication date	Comments / Purpose
Satellite Product Assurance Plan	Supplier	PDR	It gives the rules applicable to the satellite follow up
Satellite Configuration Items Data List	Supplier	PDR CDR FAR	It gives the references of the documents useful for the supply, the fabrication, the tests and deliveries of products
Satellite Qualification Status list	Supplier	CDR, FAR	It gives the qualification state of each equipment, sub-system, system.
Satellite Deviations List	Supplier	PDR, CDR, FAR	It lists the deviations emitted by the suppliers.
Payload Material and Mechanical Part List	Customer	CDR - 2 months	
Payload Process List	Customer	CDR - 2 months	
Payload EEE part List	Customer	PDR - 2 months	
OBSW Software Quality Assurance Plan (to be discussed)	Supplier	PDR	It gives the rules to implement the software
Payload Reliability analysis	Customer	PDR, CDR	
Payload Safety analysis	Customer	PDR, CDR	it studies the design conformity regards to the rules applicable on launch sites
Satellite Material and Mechanical Part List	Supplier	CDR	
Satellite Process List	Supplier	CDR	
Satellite EEE part List	Supplier	PDR	
Satellite Reliability analysis	Supplier	PDR, CDR	
Satellite Safety analysis	Supplier	PDR, CDR	

**10.2.4 DOCUMENTS RELATING TO DEVELOPMENT AND VALIDATION LOGIC****10.2.4.1 Development and Validation plans**

Title	Issued by	Publication date	Comments / Purpose
Payload Design, Development & Validation Plan	Customer	T0 phase B T0 phase C	This document defines the development, qualification model, tests philosophy to comply with satellite interfaces, environment and planning and also how to validate it.
Payload Verification Plan & Test Matrix	Customer	T0 phase C T0 phase D	See here below.
Satellite Development & Validation plan	Supplier	PDR CDR	This documents describes the philosophy chosen for satellite validation (cf. PUM & PDIS)

10.2.4.1.1 Verification Plan

The Verification Plan shall describe how the Payload will verify each requirement of the PDIS and PUM (Test, Analysis...).

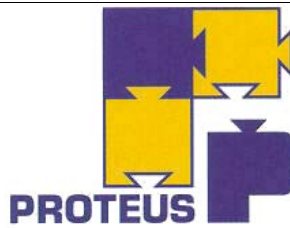
10.2.4.1.2 Test Matrix

In addition to the Verification Plan, a Test Matrix shall be prepared that summarizes all the tests that will be performed on the payload. The purpose of the matrix is to provide a quick reference to the contents of the test program in order to prevent the deletion of a portion thereof without an alternate means of accomplishing the objectives; it has the additional purpose of ensuring that all flight hardware has seen environmental exposures that are sufficient to demonstrate acceptable workmanship. In addition, the matrix shall provide a review of the qualification heritage of hardware. All flight hardware, spares and prototypes (when appropriate) shall be included in the matrix.

The Test Matrix shall be prepared in conjunction with the initial Verification Plan and shall be updated as changes occur.

10.2.4.2 Specifications of facilities for satellite integration and system tests

Title	Issued by	Publication date	Comments / Purpose
Technical Requirements of payload simulator	Supplier	PDR	This documents lists the requirements for payload simulator
Payload functional and interfaces model for validation benches	Customer	CDR	Numerical models useful for validation bench
Payload Simulator User's Manual	Customer	for BV adaptations	

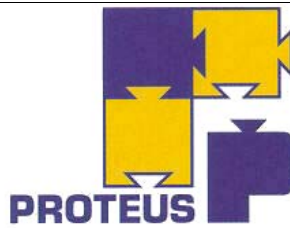


10.2.5 TEST PLANS, ASSEMBLY INTEGRATION AND TESTS

Title	Issued by	Publication date	Comments / Purpose
Payload AIT Plan	Customer	PDR CDR	Integration and test plan at payload level
Payload AIV requirements	Customer	T0 phase B T0 phase C	Defines Payload verification and tests at satellite level
Payload User's Manual	Customer	T0 phase C and at PL FM delivery	These inputs are useful for satellite AIT
Payload End Item Data Package	Customer	CDR and with PL FM delivery	Data package to be delivered with the payload flight model
Satellite AIT plan	Supplier	PDR CDR	Integration and test plan at satellite level
Payload integration (on satellite) procedures	Supplier	for satellite AIT - 3 months	For Customer approval to verify Payload safety during satellite AIT.
Satellite End Item Data Package	Supplier	FAR	Data package to be delivered with the satellite flight model.

10.2.6 SYSTEM DESCRIPTION AND PERFORMANCES

Title	Issued by	Publication date	Comments / Purpose
Satellite executive summary	Supplier	PDR CDR	Presentation of SL architecture
Satellite budgets and margins	Supplier	PDR CDR FAR	It presents mass, fuel, power & energy, link, TM & TC, pointing & stability, reliability & availability budgets and margins at satellite level.
In Orbit Test Plan	Supplier	PDR CDR	
Satellite mechanical ICD	Supplier	PDR CDR	
Satellite electrical ICD	Supplier	CDR	
Functional synoptic	Supplier	PDR, CDR + every major modification	

**10.2.7 JUSTIFICATION DOCUMENTS**

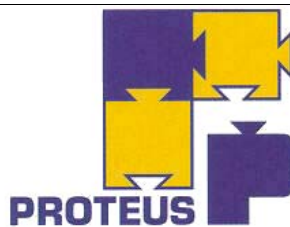
Title	Issued by	Publication date	Comments / Purpose
Design Verification Matrix and conformity to PDIS requirements	Customer	PDR CDR	
Satellite justification files	Supplier	PDR CDR FAR	It gives all the specific justification documents for each functional chains. The generic ones are given in the PROTEUS justification documents.
Design Verification Matrix and conformity to satellite requirements	Supplier	PDR CDR FAR	
Design Verification Matrix and conformity to On board/Ground requirements	Supplier	PDR CDR FAR	

10.2.8 SYSTEM DATA BASE AND OPERATIONS

Title	Issued by	Publication date	Comments / Purpose
Command control and Operations User Manual	Supplier	CDR, FAR - 6 months	
Satellite Telemetry plan	Supplier	PDR, CDR, FAR	
Satellite Telecommand Plan	Supplier	PDR, CDR, FAR	
Satellite Simulator User's Manual	Supplier	phase D	

10.2.9 MISSION CENTRE/PROTEUS GENERIC GROUND SEGMENT INTERFACES DOCUMENTATION

Title	Issued by	Publication date	Comments / Purpose
Proteus User's Manual	Supplier	NA	2 chapters deal with the generic ground segment and its interfaces
Command Control Ground Segment Description	Supplier	NA	
Ground Segment System Description	Customer	CDR	
PGGS adaptation specification	Supplier	CDR	
PGGS Interfaces	Supplier	CDR	Δ with respect to the PUM
Network interfaces architecture	Supplier	CDR	



10.3 PROTEUS PROVISION

10.3.1 PAYLOAD MECHANICAL MATHEMATICAL MODELS

PL - 10.3.1 -1

These models shall be delivered by Payload Supplier to lead mechanical and thermal analysis at the following dates:

- Beginning of the Satellite pré phase B
- Beginning of the Satellite phase B (T0)
- Beginning of the Satellite phase C (T0 + 4)
- After payload environment tests (correlated model)

The requirements are given in section 4.6

10.3.2 PAYLOAD CAD MODELS

PL - 10.3.2 -1

These models shall be delivered by Payload Supplier at the following dates:

- Beginning of the Satellite pré phase B
- Beginning of the Satellite phase B (T0)
- Beginning of the Satellite phase C (T0 + 4)

The requirements are given in section 4.6

10.3.3 PAYLOAD FUNCTIONAL INTERFACES MODEL (EM OR PAYLOAD SIMULATOR ?)

PL - 10.3.3 -1

These interfaces shall be delivered by Payload Supplier for validation bench (BV) adaptation phase (T0+11).

A preliminary definition of this model is given in section 6.1.2.

10.3.4 DELETED

10.3.5 STAR TRACKER PROVISION

A Star Trackers Assembly composed of a STA flight model equipped with mechanical breadboard of 2 STRs, with its associated STA User's Manual, will be provided by ALCATEL SPACE to Payload Supplier for the Payload environment tests. A STA User's Manual model shown in appendix D permit to see in particular the STA integration procedure requirement.

The Star Trackers Assembly (Flight model) will be integrated on Satellite at ALCATEL SPACE.

The Star Trackers wiring harness (between STR and platform) will be provided by ALCATEL SPACE.

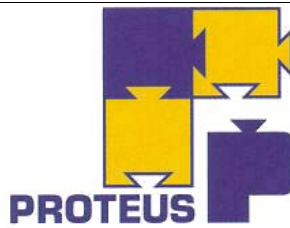
PL - 10.3.5 -1

The Star Tracker Assembly thermal control harness (monitoring and active thermal control) shall be provided by the Payload Supplier with ALCATEL SPACE requirements.

10.3.6 PLATFORM/PAYLOAD INTERFACES WIRING PROVISION

10.3.6.1 Platform/Payload power interfaces

Bracket H01 (platform/payload power interfaces bracket) and wiring from platform to this bracket are provided by ALCATEL SPACE.



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PL - 10.3.6 -1 a

Wiring from this bracket to the Payload shall be made by Payload Supplier, but connectors (P01 to P03 and P06 to P08), on payload side, will be provided by ALCATEL SPACE.

10.3.6.2 Nominal & Redundant Platform/Payload TM/TC interfaces

Wiring from platform to the Platform/Payload TM/TC interfaces brackets H02 and H03 will be provided by ALCATEL SPACE.

Brackets H02 and H03 will be also provided by ALCATEL SPACE.

PL - 10.3.6 -2 a

Wiring from these brackets to the payload shall be provided by Payload Supplier, but connectors (J01 to J07 and J09 to J12), on payload side, will be provided by ALCATEL SPACE.

10.3.7 THERMAL MLI

PL - 10.3.7 -1

MLI protection for H02 and H03 brackets shall be provided by the Payload Supplier and it shall be possible to dismount these MLI several times.

MLI protection between the payload and the platform will be provided by ALCATEL SPACE.

PL - 10.3.7 -2

The Payload shall contain attachment points for the previous MLI between the payload and platform.

PL - 10.3.7 -3

Deleted

10.3.8 PLATFORM/PAYLOAD INTERFACES SCREWS

PL - 10.3.8 -1

For each type of delivered screws, the associated torquing tools shall be provided by the Payload Supplier

10.3.8.1 Payload interface screws

PL - 10.3.8 -2

The 4 x 4 platform/payload interface M8 screws shall be provided by the Payload Supplier.

10.3.8.2 STA interface screws

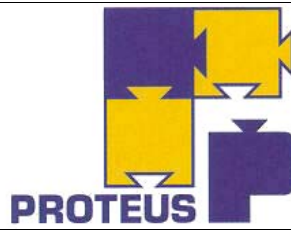
PL - 10.3.8 -3

The 8 STA/payload interface M5 screws shall be provided by the Payload Supplier.

10.3.8.3 Electrical brackets interface screws

PL - 10.3.8 -4

The 6 bracket/payload interface M5 screws shall be provided by the Payload Supplier for each bracket (H02 and H03).



END OF CHAPTER