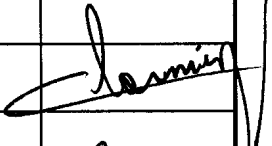**HERSCHEL / PLANCK**
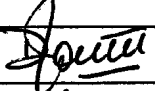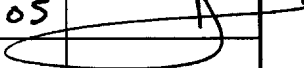
Satellite
AIT software management plan

H-P-1-ASP-PL-0420

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Rédigé par/*Written by*	Responsabilité-Service-Société *Responsibility-Office -Company*	Date	Signature
JP. HAYET	Technical AIT Manager	15/11/04	
Vérifié par/*Verified by*			
JY. CHARNIER	AIT Manager	15/11/04	
Approbation/*Approved*			
D. MONTET	AIV Manager	17.11.04	
C. MASSE	Product Assurance Manager	19.11.04	
J-J. JUILLET	Project Manager	04.02.05	

Data management : G. SERRA

Entité Emettrice : Alcatel Space - Cannes
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ENREGISTREMENT DES EVOLUTIONS / *CHANGE RECORDS*

ISSUE	DATE	§ : DESCRIPTION DES EVOLUTIONS *§ : CHANGE RECORD*	REDACTEUR *AUTHOR*
1/0	7/11/2002	Preliminary issue	JP Hayet
2/0	15/04/2003	All the document: change generic statement "common software management tool" to MOIS §1.2: Add perimeter of this document & [AD7] introduction § 1.3: MOIS definition §2.1: add [AD6] & [AD7] §2.1: add [RD5] for word definition §2.2: add [RD6] §3.1: rewritten §3.2.2: sequence name. Add some requirements for the naming of the sequence name in order to use the option "instantiation" of MOIS §3.2.3: ref to [AD7] synoptic pictures name. Add some requirements for the naming of the synoptic pictures name in order to manually use the same philosophy as the sequence name §3.2.3: old §3.3 renamed §3.2.3 §4.1: recoding and validation of test sequences will be implemented at PLM, AVM & satellite levels (AVM added) [AD3] is mandatory required documents clarification: flow-charts, list of the local parameters used, list of the HPSDB parameters, TM/TC packets, curves used §5.1: add validation of the HPSDB §5.2: add information about configuration management tools §6: MOIS required §8: MOIS required	JP Hayet
2/1	16/01/2004	[AD7] reference modification §3.2.2: refer to [AD7] §3.3: refer to [AD7] §5.2: for test sequences management, MOIS and CCS management tools will be used	JP Hayet
2/2	15/11/2004	§1.2 modification according to answer RID DAIV-0906 §4.1 modification according to answer RID DAIV-0906 §5 modification according to answer RID DAIV-0906 §1.3 modification according to answer RID DAIV-0605 §5.4 modification according to answer RID DAIV-0907 §3.1 and §3.2.1 clarification about parameters use §3.2.2 all example modifications according to new naming convention of the test sequence (report to [AD7])	JP Hayet

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1. INTRODUCTION

1.1 Purpose

The scope of this document is to specify the requirements for the development of the Test S/W to be used during Integration and Test activities on both HERSCHEL and PLANCK from element to model level, including subsystem level (for word definition see [RD5]).
This Satellite AIT Software Management Plan document shall be considered as a guideline to be followed when S/W elements for the different AIV activities have to be developed.
The Software Management Plan will establish requirements for the overall AIT S/W architecture and will contain rules for the AIT S/W design and development (the Test Sequences and the Synoptic Pictures).
The basis document is the AIT software management plan [AD4] written for the SVM. As the test equipments are the same at SVM and Satellite level, the AIV tests sequences used will be mainly the same. This document deals with the difference or additional tasks that will appear at instruments level, at PLM level and at satellite level.
At SVM and AVM level, some tasks have been added to [AD4] and required to be implemented (see chapters 3 and 5).
The applicability field of this document is all the H/P program activities (depend of the chapters):
- stand alone instruments tests
- P-PLM & H-EPLM
- SVM (enclosing ACMS)
- H/P satellites

For all the models: FUMO, EQM/CQM, PFM

1.2 Perimeter of this document

This document only deals with:
1) the test sequences, the synoptics that will be created/modified by the AIT teams for integration & test at different levels (sub-system, AVM, SVM, PLM, satellite).
2) the links with the HPSDB.

An other document [AD7] is issued. The goal of this document will be to define rules to be followed by all the parties :
- how to use MOIS
- how to manage the test sequence compatibility between AIT and operation

This document is strickly linked with the document [AD7]. All together answer to the ESA OIRD requirement "FUMC-7" (the procedure presented in the SUM shall be validated at spacecraft system and subsystem level testing).

The AIT software can not be considered as a software application. It is a list of Test sequence plan (see descriptive in the annexe 2 of [AD7]. The test sequence plan will be defined before the test in the detailed test specifications. These documents are written and approved by the architects and the instruments teams. The validation and the verification of these test sequences will be done with a MOIS tool (called "validator"). After running through **all the loops**, the status of the sequences will be "validated".
There will be several disk, one for the "non-validate" test sequence, an other with the "validate" test sequence.

1.3 MOIS definition

MOIS (Mission Operations Information System) is a COTS (Commercial Of The Shelf) tool developed for operations activities. It has already been successfully used on Rosetta in the frame of AIT, but limited to avionics AIT.

For Herschel / Planck, it is proposed to use it mainly to:

. develop all module and system AIT test sequences

. validate operation procedures part of satellite user manual to be delivered by ASP

The use of MOIS in AIT will allow supporting the "smooth transition" between the different level of tests. This will be obtained by ensuring of common way to develop test sequences and to document them. MOIS supports also the merging of several libraries in one in order to support the merging of the SVM test sequence set and PLM test sequence set in one set: the system test sequence set.

The use of MOIS to validate operation procedures will allow to support the "smooth transition" between system AIT and operation. This will be obtained by generating, from the same MOIS "source", the system AIT test sequences under the CCS test language (TOPE) form and the operation procedures under paper form and/or TC sequences.

In addition, MOIS supports some additional features which make it very attractive:
-   consistency check with HPSDB (Herschel / Planck System data Base)
-   cross check generation between test sequences, between test sequence and HPSDB
-   configuration control of supporting written/paper test sequence

Note: for specific reasons, AIT tests sequences using TOPE could be generated directly fromm CCS tools (TOPE editor).
•   For satellite safety reasons, in case of non foreseen behaviour (safety loop occurrence, FDIR occurrence for instance).
•   For complex parameters computation and/or timing issue (ACMS performances tests for instance).

In that case, these types of AIT test sequences are and will be specific AIT test sequences, not to be delivered for operation activities. All test sequences to be delivered for operation purposes shall be generated with the use of MOIS.

2. APPLICABLE AND REFERENCE DOCUMENTS

2.1 Applicable documents

[AD1]	H-P-4-TE-MA-0010	CCS SUM
[AD2]	H-P-1-ASPI-TN-231	Herschel / Planck System Database guide
[AD3]	H-P-1-ASPI-SP-0141	Herschel / Planck Naming Convention Specification
[AD4]	H-P-PL-AI-0012	SVM AIT software management plan
[AD5]	S2K-MCS-ICD-0001.TOS-GCI	SCOS2000 data base import ICD
[AD6]	H-P-4-TE-ID-8020	CCS external ICD
[AD7]	H-P-1-ASP-TN-0575	MOIS – Rules to support modularity and commonality

2.2 Reference documents

[RD1]	H-P-1-ASPI-SP-0045	EGSE Requirements Specification
[RD2]	H-P-1-ASPI-IS-0121	EGSE INTERFACE Requirements Specification
[RD3]	H-P-4-TE-DD-2020	Herschel / Planck Central Checkout System System Design Document - Hardware
[RD4]	H-P-4-TE-DD-2010	Herschel / Planck Central Checkout System System Design Document - Software
[RD5]	H-P-1-ASPI-SP-0082	System Database Specification
[RD6]		MOIS Help version 5.2.6 (*) (*) this objet is a run software tool that ca be delivered by ASP on request
[RD7]	HSCDT-TN-017	Understanding of the interfaces between the CSS and the Herschel instrument EGSEs in the IST

2.3 Acronyms

APID	Application Process Identifier
CCS	Central Checkout System
CDMU	Control and Data Management Unit
DFE	Data Front End
DS	Data Server
EGSE	Electrical Ground Support Equipment

HK	HouseKeeping
HPLM	Herschel PayLoad Module
HPSDB	Herschel/Planck System Data-Base
IST	Integrated System Test
LAN	Local Area Network
MOIS	Mission Operation Information System
MTP	Master Test Processor
OBSW	On Board SoftWare
PFM	ProtoFlight Model
PLM	PayLoad Module
PPLM	Planck PayLoad Module
SCOE	Special Check-Out Equipment
S/C	SpaceCraft
S/L	SateLlite
SVM	SerVice Module
S/W	SoftWare
TC	TeleCommand
TCC	Test Conductor Consoles
TM	TeleMetry

3. GENERAL RULES (INSTRUMENTS, AVM, SVM, PLM AND SATELLITE LEVELS)

<u>Remark:</u> [AD7] is issued in addition to this document plan to provide some more details for all the following requirements.

3.1 Parameters use

It is the user responsibility to choose the way to implement global variables either via UDC or via TCL/TK global variable. However due to SCOS real time limitation, it is not authorised to use UDC as parameter of a TC even if allowed by SCOS (refer to [AD7] chapter 5).

3.2 Naming convention

3.2.1 Parameters

All the UDC parameters used in the test sequences foreseen to run in the CCS at any test level shall be implemented in the HPSDB (see 3.1). So, the name of these parameters must be compliant with [AD3]. TCL/TK global variable are not managed by HPSDB.

3.2.2 Sequence name

The sequence management will not be supported by the HPSDB.

The test sequence name as specified in [AD4] shall be encapsulated depending of the level (element / subsystem / model / generic) where the test sequence applies.

For more information, refer to [AD7]

<u>Element:</u>
If a test sequence applies at element level, its refers only to items belonging to the same element, its name shall be compliant with [AD4].
Examples :   . < level >< type ><category>< id ><mnemonic>
                <1 char><1 char>< 2 char ><3 dig>< 20 char >
                  .   E   T   FC   001   STRDUMP

<u>Subsystem:</u>
If an element test sequence has to be used at subsystem level, then using MOIS (option instantiation), it will be possible to automatically instantiate it with the subsystem identifier (first, second, third and fourth characters) and the position of the element (fifth, sixth and seventh characters).
Examples :   . ETFC001STRDUMP   instantiated in   A001020ETFC001STRDUMP
                (in this example the STR is allocated to subsystem A001 in position 020 which can be the nominal one - According to [AD3] the fist character of the subsystem identifier is the subsystem type : ACMS in the example).

If a test sequence applies at subsystem level only (cannot be defined at element level), its refers only to items belonging to different elements which belong to the same subsystem. The name as specified in [AD4] shall be encapsulated with the subsystem identifier (first, second, third and fourth characters) and with a subsystem pseudo-position (fifth, sixth and seventh characters) according to [AD3].

Example :   . <subsystem_ID><pseudo_position><AD4name>

           . A001108SPXX001ACMSPERF

           (Note : According to [AD3], 108 is a pseudo-position for ACMS subsystem).

Model:

If a subsystem test sequence has to be used at model level, it will be used using the same name : there is no instantiation (this is possible because there is at most one subsytem per subsystem type allocated to a model).

Examples :   . A001020ETFC001STRDUMP

           . A001108SPXX001ACMSPERF

If a test sequence applies at model level only (cannot be defined at element or subsystem levels), its refers only to items belonging to different elements and subsystems which belong to the same model. The name as specified in AD4 shall be encapsulated with a pseudo_subsystem identifier (first, second, third and fourth characters) and with a subsystem pseudo-position (fifth, sixth and seventh characters) according to [AD3].

Example :   . <Pseudo_subsystem_ID><pseudo_position><AD4name>

           . Z001999MPXX001ACMSPERF

           (Note : According to [AD3], Z is the pseudo_subsystem and 999 is a pseudo-position for the pseudo subsystem).

Generic:

If a test sequence is a generic one, it is independant of the different levels, then the name as specified in AD4 shall be encapsulated with the generic subsystem identifier (first, second, third, fourth characters) and with the generic pseudo position (fifth, sixth and seventh characters) according to [AD3].

Example :   . <Generic_subsystem_ID><generic_position><AD4name>

           . G001000ET001SQUAREROOT

3.2.3 Synoptic pictures name

The tools used to create the synoptic pictures are standard tools of SCOS2000.

The synoptic picture name as specified in [AD4] shall be encapsulated depending of the level (element / subsystem / model / generic) where the synoptic picture applies.

If a synoptic picture applies at element level, its refers only to items belonging to the same element, its name shall be compliant with [AD4].

Examples :   . <AD4name>

           . STRDUMP

If an element synoptic picture has to be used at subsystem level, then it shall be manually copied and its name instantiated with the subsystem identifier (first, second, third and fourth characters) and the position of the element (fifth, sixth and seventh characters).

Examples : . <AD4name> instantiated in <Subsystem_ID><Position><AD4name>
. STRDUMP instantiated in A001020STRDUMP
(in this example the STR is allocated to subsystem A001 in position 020 which can be the nominal one - According to [AD3] the the fist character of the subsystem identifier is the subsystem type : ACMS in the example).

If a synoptic picture applies at subsystem level only (cannot be defined at element level), its refers only to items belonging to different elements which belong to the same subsystem. The name as specified in [AD4] shall be encapsulated with the subsystem identifier (first, second, third and fourth characters) and with a subsystem pseudo-position (fifth, sixth and seventh characters) according to [AD3].

Example : . <subsystem_ID><pseudo_position><AD4name>
. A001108ACMSPERF
(Note : According to [AD3], 108 is a pseudo-position for ACMS subsystem).

If a subsystem synoptic picture has to be used at model level, it will be used using the same name : there is no instantiation (this is possible because there is at most one subsytem per subsystem type allocated to a model).

Examples : . A001020STRDUMP
. A001108ACMSPERF

If a synoptic picture applies at model level only (cannot be defined at element or subsystem levels), its refers only to items belonging to different elements and subsystems which belong to the same model. The name as specified in AD4 shall be encapsulated with a pseudo_subsystem identifier (first, second, third and fourth characters) and with a subsystem pseudo-position (fifth, sixth and seventh characters) according to [AD3].

Example : . <Pseudo_subsystem_ID><pseudo_position><AD4name>
. Z001990ACMSPERF
(Note : According to [AD3], Z is the pseudo_subsystem and 990 is a pseudo-position for the pseudo subsystem).

If a synoptic picture is a generic one, it is independant of the different levels, then the name as specified in AD4 shall be encapsulated with the generic subsystem identifier (first, second, third, fourth characters) and with the generic pseudo position (fifth, sixth and seventh characters) according to [AD3].

Example : . <Generic_subsystem_ID><generic_position><AD4name>
. G001000SQUAREROOT

3.3 Compatibility AIT / operations

Remark: refer to [AD7]

The test sequences shall be written in such a way that they can be re-used to the maximum extend to generate the operations procedures to be inserted inside the Satellite User Manual.

Document [AD7] has been written by ASP in order to specify the way to use MOIS and the rules to follow including the ones relevant for the re-use of AIT test sequences as operations procedures.

As first analysis one can say that all the SCOE management statements shall be isolated in separate test sequences in order that those dedicated SCOE test sequences can be replaced by "dummy" test sequences to generates operation procedures.

It is evident that it will not be possible to generate all the operation procedures from the AIT test sequences (the environment are differents, …). It is also evident that all test sequences will not be used to generate operations procedures.

However, in order to simplify the way to satisfy the ESA requirement to validate the operation procedures in AIT, it is required to follow the rules which will be given by ASP in order to satisfy to the maximum extend this requirement.

4. INSTRUMENTS STAND-ALONE TESTING

The stand-alone tests of all the Herschel & Planck instruments will be performed using specific configuration with SCOS2000 to manage the test sequence, the HK telemetry monitoring, the OBS management (partial simulation of the OBSW).
Herschel instruments and Planck instruments EGSE are differents. Herschel instruments EGSE is described in [RD7], Planck instruments EGSE is described in [TBD].

4.1 Test sequences

The re-use of the test sequences developed and validated at the instruments level will not be achieved because:
- instrument stations are not allowed to send commands to the satellite
- Planck instruments EGSE's do not use a test language compatible with the CCS

So, the test sequences portability will not be 100 % possible for both Herschel and Planck. Recoding and validation of test sequences will be implemented at PLM, AVM & satellite levels.

In order to facilitate this task, it is mandatory to follow [AD3] including specific requirements to instruments, and the maximum possible effort shall be done to follow the rules defined in [AD4].

In order to increase the efficiency of the portability, instruments teams shall deliver to Alcatel/Astrium the test sequences with at least following documentations :
- flow charts
- list of local parameters used
- list of HPSDB parameters, TM & TC packets, curves used

The recoding of the sequences provided by the instrument teams is foreseen. This recoding will consist only to package the instrument test sequence in MOIS form without modifying the test sequence contains.

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Nota: the test sequences involved for the portability to the CCS are only the ones used for instruments set-up (telecommand sending) and checks (telemetry reading). According to [RD2], all the sequences used for scientific data treatment purposes will never run in the CCS. At PLM and satellite level, the scientific data will be sent directly to the instruments EGSE throught the CCS.

4.2 Data base

A system database shall be used. The instruments equipments (EQM, PFM, FUMO models) will be delivered to the satellite with theirs own data-bases which shall be compliant with [AD5] and will be loaded inside the HPSDB.

The experimenters shall be in charge of the populating and validating of the contents of the HPSDB with ASP support.

5. GENERAL RULES (AT AVM, SVM, PLM AND SATELLITE LEVEL)

Note: SVM includes ACMS activities using ACMS EGSE.

5.1 MOIS: Common software management tool use

All the software activities (test sequences, synoptic pictures) will be compliant with [AD3] & [AD4].

In addition, the use of a common software management tool called MOIS to manage the test sequences is mandatory. This software tool will guarantee or support:

- the tracability of the test sequences (history, flow-chart documentation)
- the structural organization of the test sequences (test sequences created/modified with flow-chart)
- the coherency between the test sequences and the HPSDB
- the cross reference between HPSDB objects and test sequences
- the modularity of test sequences at element, subsystem and model levels
- the validation at least of the test sequences, synoptic picture, HPSDB before running for test purposes
- the documentation: flow-charts, list of parameters

As the same test sequences will be used at differents levels, at differents areas, with differents teams; the use of MOIS will increase their understanding.

The use of MOIS is mandatory at AVM, SVM, PLM and satellite levels. This allows all the teams working in Herschel-Planck program to use the same tool. As the document [AD7] required to generate modular test sequence, the transition between the SVM level to the satellite level will be easier.

For exemple:
Start of satellite config
    Start of SVM config
    Call subsystem CDMS "nominal conf"   ->   sequence delivered by ALS
    Call subsystem ACMS "nominal conf"   ->   sequence delivered by ALS
    Call subsystem TTC "nominal conf"   ->   sequence delivered by ALS

End of SVM config
Start of PPLM config
Call subsystem HFI "science config"   ->   sequence delivered by ASP (with HFI team)
Call subsystem LFI "science config"   ->   sequence delivered by ASP (with LFI team)
End of PPLM config
End of satellite config

Before the SVM delivery, a MIP will be done in order to check the validity and the status (version number) of all the test sequence delivered by ALS.

Note: for ACMS activities, all the test sequences that will run in the CCS later on shall be created/modified with the use of MOIS. The ACMS test software used for the subsystem performances and that at any case never run in the CCS is not involved with this requirement.

5.2 AIT software configuration management

The AIT software objects involved are at least test sequences, synoptics, data files. The AIT software of each models and satellites are involved too with this configuration management.

The configuration management allows to manage the differents issues of all the AIT software objects.
At the end of masters phases of all the models (integration, performances, satellite integration, environmental tests, launch site activities), at models delivery (ACMS, SVM, PLM, satellite), a status shall be issued and configured (official documents form). All the models and satellites are involved.
For the test sequences, MOIS and CCS configuration management tools will be used.
For the synoptic pictures, CCS configuration management tool will be used.
The configuration management allows to manage the belonging of all the AIT software objects. One object could be common (the same for all models), could be differents (for example, Herschel ACMS will be different to Planck ACMS).

5.3 Data base

According to [AD2], HPSDB supports all the models of the H/P program, all the subsystems and equipments of the models & all the EGSE (only RC and RM data are involved). The usage of HPSDB (central and mirror sites) is mandatory.

5.4 AIT software maintenance

The AIT software sequences will be delivered either by ALS (for the SVM test sequences) or the instrument teams (for the instrument test sequences). After delivery of them, their updating in case of failure or incoherency between subsystem level and satellite level will be done by the company in charge of the satellite AIT. If needed, ALS or instrument teams experts will be in the loop to implemente these modifications. The company in charge of these modifications will be in charge of the management of them.

6. AVM AND SVM TESTING

SVM includes ACMS activities using ACMS EGSE.

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The reference document for the AVM and SVM is [AD4]. In addition, the different rules defined in chapter 3 and 5 of this document shall be required. In particular, the use of MOIS is required. All the AIT software delivered with the different models have to be generated/managed with MOIS.

To the maximum extend the AIT software shall be common for the AVM and the two SVM's.
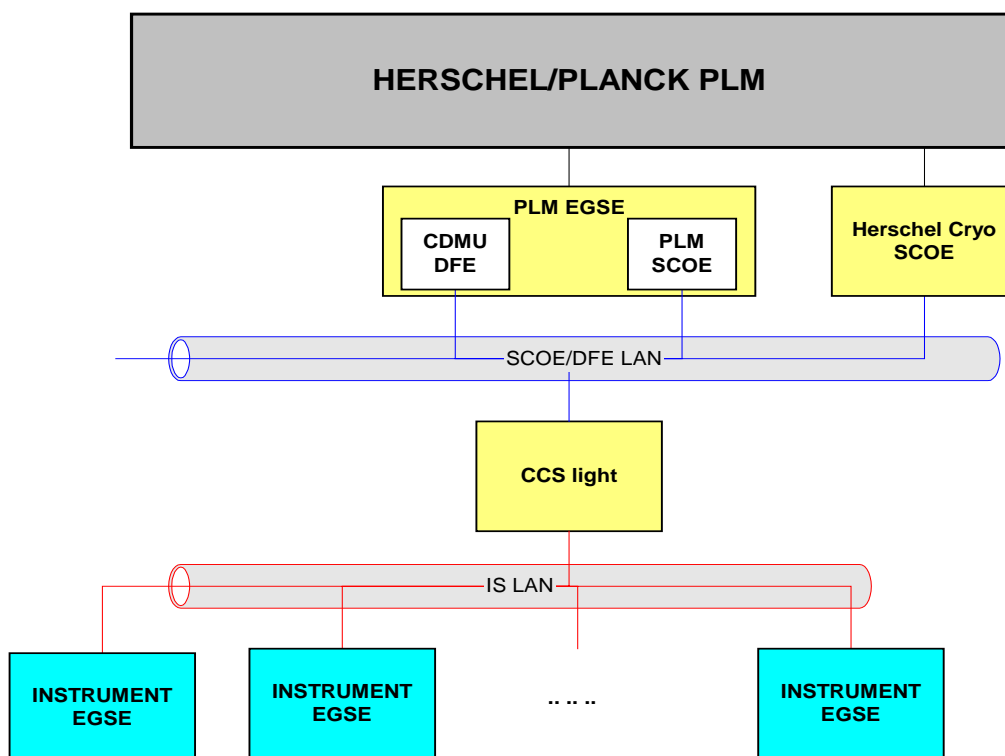
7. PLM TESTING

FIGURE 1: PLM EGSE CONFIGURATION

Note: figure 1 shows the H-EPLM configuration. The PPLM configuration is roughly the same, only the Herschel Cryo SCOE is absent.

The PPLM & H-EPLM AIT activities will be performed with a SVM simulator (called PLM EGSE enclosing PLM scoe and CDMU DFE in the schematic above) connected to the WU of instruments CQM. It will be the first time that the CCS will be connected to the WU. Herschel satellite team, Planck satellite team & instruments teams will take profit of this set-up to run the test sequences. Instrument team will be in charge of the delivery of:

- All the data to the HPSDB (for instance: parameters list, limit set for monitoring, curves) according to [AD5] & [AD3]
- the synoptic pictures used at instrument level
- the test sequences used at instrument level
- the test sequences documentation

Herschel / Planck AIT teams will be in charge of the recoding & validation of the test sequences delivered by instruments teams (with their support) with the use of MOIS.

One of the main functionality of the PLM EGSE is to simulate the CDMU software (in term of input/output). All the telecommands sent to the satellite, all the telemetries received from the satellite will be the same at PLM and satellite level. Test sequences run during PLM tests will be considered validated for satellite testing.
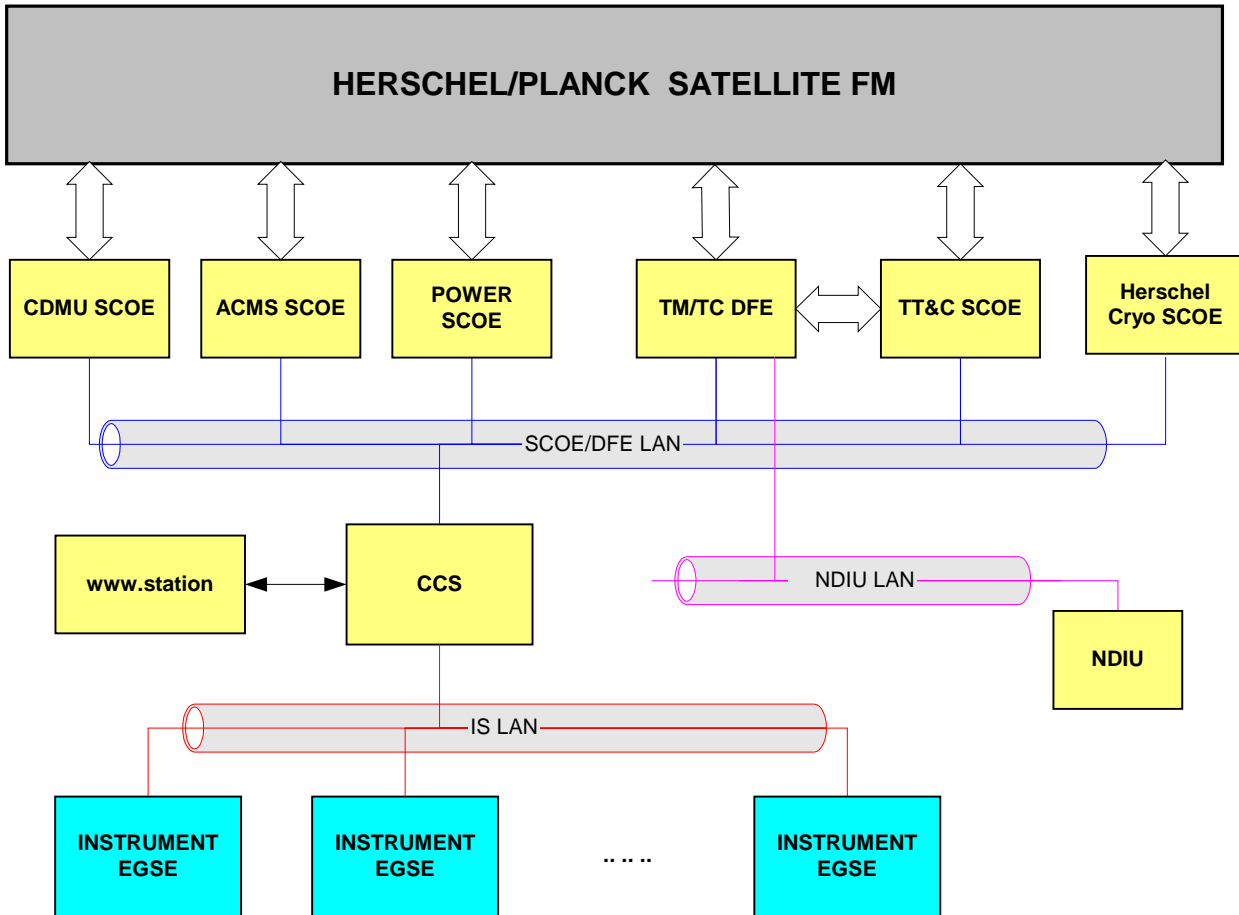
8. SATELLITE TESTING

FIGURE 2: SATELLITE EGSE CONFIGURATION

The Herschel / Planck satellites will be tested using:

- <u>SVM test sequences:</u> they will be validated at SVM level. All the activities to manage these test sequences will be compliant with this document (also for MOIS purposes). The SVM test sequences will be completly compatible with the satellite level testing.

- <u>PLM test sequences:</u> they will be validated at PLM level. All the activities to manage these test sequences will be compliant with this document (also for MOIS purposes). All the PLM test sequence involved for the WU's control/command will be completly compatible with the satellite level testing. For the interface aspects with the scoe's, the PLM test sequences will not be completly compatible due to the fact that the PLM EGSE I/F (used at PLM level) will be different than the CDMU and the Power scoe I/F (used at satellite level).

- <u>Satellite test sequences:</u> the master sequences will be created to configure the complete satellite for the system tests. Nevertheless, these master sequences will call as much as possible sequences already

used for the SVM and the PLM testing. All the activities to manage these test sequences will be compliant with this document (also for MOIS purposes).

- <u>Synoptic pictures:</u> they will be validated at SVM and PLM level. Some of them will be created at satellite level in order to simplify the monitoring of the satellite. All the activities to manage these synoptic pictures will be compliant with this document (except for the MOIS purposes).

END OF DOCUMENT

Référence du modèle : **M023-3**