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HERSCHEL / PLANCK

AIT Monitoring Convention Specification

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1. INTRODUCTION

This document describes naming convention, location and practical implementation of main cases of AIT monitoring that will be implemented and used on SCOS-2000

Document first presents the MIB data library dealing with monitoring.
Each category of data will be standardly categorized, and named with appropriate convention.
Principles will be present in a logical scheme.
Monitoring library will be describe in a thematic way, and then applied to particular cases.

2. APPLICABLE AND REFERENCE DOCUMENTS

2.1 Applicable Documents

2.2 Reference Documents

[RD1]	H-P-1-ASPI-SP-041	2.0	Naming Convention Specification
[RD2]	S2K-MCS-ICD-0001-TOS-GCI	5.1	SCOS-2000 Database Import ICD
[RD3]	H-P-4-TE-MA-0010	2.2	CCS System User Manual



3. MIB LIBRARY

MIB files dealing with monitoring are the ones mentioned as below

3.1 Related to parameters

3.1.1 '*pcf.dat*'

Parameter characteristics file, containing the definition of monitoring parameters

3.1.2 '*ocf.dat*'

Out Of Limits checks file, defining the characteristics of all the checks applied to a specified parameter

3.1.3 '*ocp.dat*'

Out Of Limits definition file, defining the allowed (ranges of) values for monitoring parameters

3.2 Related to command pre-validation

3.2.1 '*ccf.dat*'

It contains command property, with the 'Hazardous' flag that specifies if command is critical or not (Could not be send without specific unlock command)

3.2.2 '*ptv.dat*'

Command pre-transmission validation file, which defines the monitoring parameter and value pairs to satisfy validation

3.3 Related to command verification

3.3.1 '*cvs.dat*'

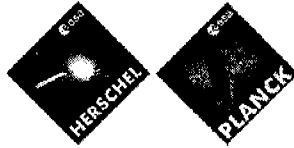
Verification stages file characteristics

3.3.2 '*cve.dat*'

Verification expression file, which defines the monitoring parameter and value pairs to satisfy verification

3.3.3 '*cvp.dat*'

Verification profiles : definition of which stages are applicable to which command/sequence



4. SCOS2000 MONITORING PRINCIPLES

4.1 Command/Control link

- Sending command from ground with critical flag ('**Hazardous**') and **Pre-transmission** conditions (or prerequired condition)
- Evaluate **Command Verification Stages** (or Command Consequences), to update status **Consistency** (or Go/Nogo state) check of related telemetry parameters.

4.2 Validity & Limits

- Check **Validity** of a telemetry parameter in order to guarantee pertinent analysis
- Check telemetry **Limits** in order to trig alarm on critical situation
Limits can be decline in different level, but all active at a same time:
 - ✓ Delta and Soft OOL (or Normal Surveillance)
 - ✓ Hard OOL (or Emergency Surveillance)
 - ✓ Status Consistency Check (or Go/Nogo state), using Command Verification Stage check (Command 'Consequences' link to 'Parameter Expected Value')

4.3 Means of monitoring

Computation of **Synthetic parameters**. There are provided user parameters, derived from **Static or Dynamic Constant**, and computed variable (telemetry and/or synthetic parameters equation)

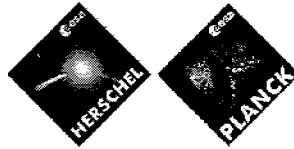
4.4 Synthesis

4.4.1 Description

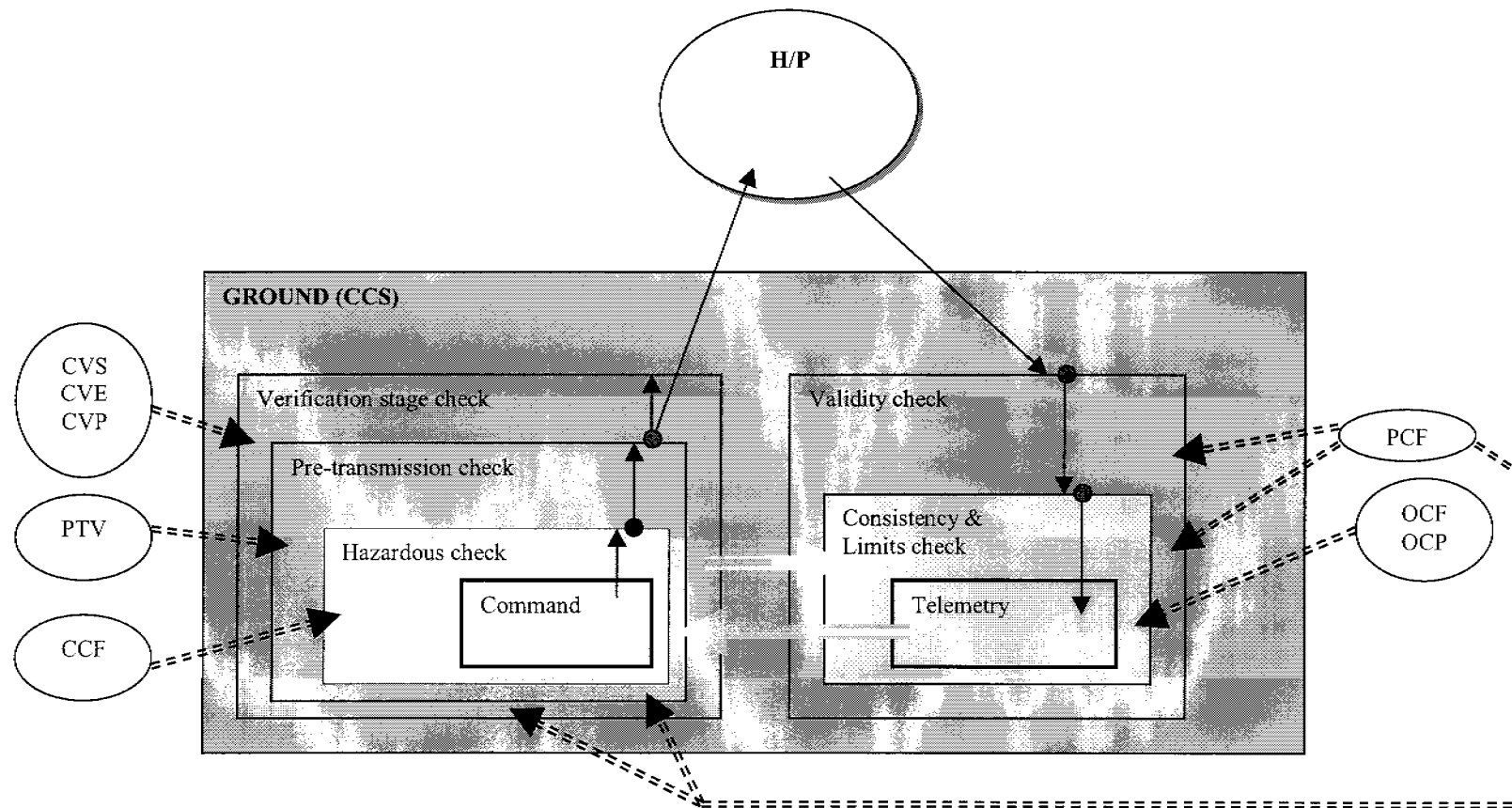
We can conclude that monitoring responding at different stages of verification, both in command sending interpretation process and in receiving telemetry interpretation process.

In order to achieve the full logical process of monitoring, TM/TC link exist with :

- Pre-transmission verification, i.e. a parameter conditioning a command send
- Command verification stage, i.e. a status consistency flag that guarantee expected state from command sended.



4.4.2 Scheme



5. SCOS2000 PARAMETERS LIBRARY ('PCF.DAT')

Monitoring parameters can be defined in category as below:

- Telemetry data
 - Spacecraft telemetry parameters
 - GSE telemetry parameters
- Internal SCOS data
 - Synthetic parameters
 - Dynamic OL parameters
 - Hard-coded parameters
 - Saved Synthetic parameters
 - User Defined Constant parameters

5.1 Telemetry data

5.1.1 Definition

These are telemetries return by GSE or Spacecraft

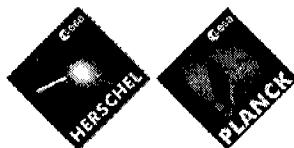
Main telemetry properties (related to monitoring)

<i>MIB Label</i>	<i>Syntax</i>	<i>Remark</i>
PCF_NAME	M*****	Naming convention [RD1]
PCF_NATURE	R	Raw telemetry
PCF_USCON	Y or N	Consistency Check On/Off (‘Y’ is mandatory if telemetry declared in OCP.dat)
PCF_VALID	<i>Validity Parameter</i>	PCF_NAME valid if => (PCF_VALID = PCF_VALPAR)
PCF_VALPAR	<i>Parameter Value</i>	

5.2 Synthetic parameters

5.2.1 Definition

These are local SCOS 2000 calculated data, used for monitoring facilities



5.2.2 Dynamic OL parameter

5.2.2.1 Definition

These are parameter calculated with an Operations Language definition.
The definition is encoded in a file, having the same name as the parameter (no extension)

<i>MIB Label</i>	<i>Syntax</i>	<i>Remark</i>
PCF_NAME	D*****	Naming convention [RD1]
PCF_NATURE	D	Dynamic OL parameter

5.2.3 Hard-coded Synthetic parameters

5.2.3.1 Definition

These are parameters calculated in a C++ predefined file, linked in the SCOS 2000 library.
It is a more efficient way to encode complex evaluation rather than OL
However, no formula dynamic visualization or edition is possible with this kind of parameter

Nota: those synthetic parameters are not contained in the HPSDB MIB Files, but only defined in the a file on the CCS

<i>MIB Label</i>	<i>Syntax</i>	<i>Remark</i>
PCF_NAME	D*****	Naming convention [RD1]
PCF_NATURE	H	Hard Coded parameter

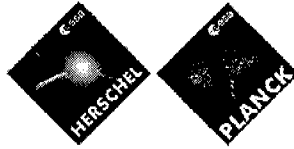
5.2.4 Saved Synthetic parameters

5.2.4.1 Definition

These are parameters equal to another synthetic parameter, but evaluated only if an element of the original parameter change.
A calculated trigger condition is also associated to a position in a Telemetry Packet.

Nota: those synthetic parameters are not contained in the HPSDB MIB Files, but only defined in the a file on the CCS

<i>MIB Label</i>	<i>Syntax</i>	<i>Remark</i>
PCF_NAME	D*****	Naming convention [RD1]
PCF_NATURE	D	Saved synthesis parameter
PCF_RELATED	Synthetic param.	Related synthetic parameter to save



5.3 User Defined Constant parameters

5.3.1 Definition

These are parameters equal to a constant, either defined in database or in a dynamic internal telemetry packet (SCOS2000 capabilities).

5.3.2 Static User Defined Constant

5.3.2.1 Definition

These parameters are constant defined in database (Constant Value is in MIB file as well). These are parameters that can usually contained Fixed Id, or Physical constant ()

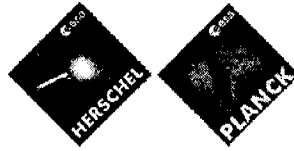
<i>MIB Label</i>	<i>Syntax</i>	<i>Remark</i>
PCF_NAME	U*****	Naming convention [RD1]
PCF_NATURE	C	Constant parameter

5.3.3 Dynamic User Defined Constant

5.3.3.1 Definition

These parameters are constants defined in a file, which can be dynamically updated. These can be suitable for monitoring purpose, adjustable by user, depending of current operations running (SC state, Integration Phase), and don't worth a database change.

<i>MIB Label</i>	<i>Syntax</i>	<i>Remark</i>
PCF_NAME	N*****	Naming convention [RD1]
PCF_NATURE	R	Like a Raw telemetry



6. MONITORING IN COMMAND DEFINITION

6.1 Command critical flag

6.1.1 Definition ('ccf.dat')

This is the command property that authorize or not the sending of a command.
Command can only be sent if the flag is reset by a voluntary user command

This flag is one of the main property of a command, so implemented in the main command file definition

6.1.2 Example

6.2 Commands pre-transmission validation

6.2.1 Definition ('ptv.dat')

This is the expression that specifies the requirement for sending a command existing in 'ccf.dat'
Expression is a check of a param value, existing as a monitoring parameter.

The expression contains the name of the command, the name of the parameter to check, the value expected, and parameter name representation (Raw or Engineering)

6.2.2 Example

MIB File Structure of file

	Command	Parameter	Representation	Value
'ptv.dat'	C00000	A06004	R	0

6.3 Commands Stage Verification

6.3.1 Declaration ('cvp.dat', 'cvs.dat')

A stage verification can be associated to each command existing in 'ccf.dat'
 When sending a command, SCOS-2000 can check if the stage criteria associated has been completed.
 A verification stage can use either:

- a TM report packet check (ESA TM packet acceptance report protocol)
- a monitoring parameter set check (user monitoring parameter definition)

6.3.2 Definition ('cve.dat')

When defining the stage verification criteria, value to match can have tolerance, and verification process window can be defined with sampling interval properties

Status consistency check of a telemetry parameter is updated if depending of command sent.

6.3.3 Example

For instance, with the existing command called C00001, we associate a verification stage, checking the raw value of an existing parameter named A06004.
 When C00001 is completed (executed on board), we want A06004 equal to 224 (raw), with 0% tolerance
 We fix a verification window that will operate with no delay, and refreshed in a sampling interval of 15s.
 The stage will set 224 as the value expected for A06004. We set this value to be the new consistency status check of A06004.

HPSDB bridge will provide MIB files as below:

MIB File

Structure of file

	Command	Type	Stage Id				
'cvp.dat'	C00001	C	1				
'cvs.dat'			1	C	V	0	15
				Completion of execution	Verification with monit param		Sampling interval for calcul. Verif. Windows
							Delta time after release before verif. Windows
'cve.dat'			1	A06004	R	224	0
				Telem	Raw	Value to match	Tolerance
							Set new value expected as the new status consistency check

7. PARAMETER CONSISTENCY AND LIMITS

For each parameter, we can define different set of monitoring limits
Basically, a monitoring limit check on a telemetry is not mandatory

7.1 Declaration ('ocf.dat')

If a parameter is declared in 'ocf.dat', it will be monitored using the main following properties:

- the number of retry before "Out Of Limits" alarm trig
- the number of check limits (Low/High value pairs) that will be define on a unique parameter (16 max)
- the interpretation expected for high and low limits
(Raw or Engineering interpretation, and Real, Integer or ASCII type)

7.2 Definition ('ocp.dat')

Parameter limit checks are detailed in 'ocp.dat'.
Each check on unique parameter is identify with an 'Id'.
We can identify four different kind of monitoring checks.

7.2.1 Out of limits library

7.2.1.1 Soft OOL / Delta OOL

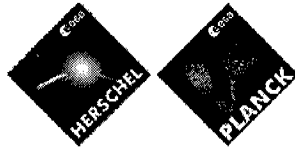
Soft or Delta OOL are Normal Surveillance and can be considered as range criterias. They can be plural, simultaneously active depending of limit selection criteria. It is passive alarm.

7.2.1.2 Hard OOL

Hard OOL are Emergency Surveillance and can be considered as range criterias. They can be plural, simultaneously active depending of limit selection criteria. It is an active alarm, i.e., a process can be associated to Hard OOL, in order to return GSE or S/C to safe configuration. The script called must be named '*danger_nameofparameter*'.

7.2.1.3 Status Consistency

It is applicable only to parameter declared with PCF_USCON = "Y" in 'pcf.dat'
Status consistency is a Normal Surveillance, but only depending of Command Stage Verification. It can be considered as a GO/NOGO Check (Command/Control logical link)



7.2.1.4 Event generation

It is a SCOS2000 Packet generation capabilities when OOL trig (Not detailed in this document)

7.3 General requirement

7.3.1 Order and priority of monitoring limits

In the list of monitoring checks, status consistency must be declared in first position (Of course, only if parameter is declared as 'consistency status' checked PCF_USCON="Y")

This check is mainly required when command and control is clearly known, such as a relay status control linked to his On/Off command.

Then, other set of limits can be declared, in a preferring following order:

- Hard OOL Most critical Action mostly required
- Soft OOL Critical Operator must prevent critical situation
- Delta OOL Alarm Operator is aware of a significant variation

7.3.2 Typical case of required monitoring

- ✓ Delta / Soft / Hard OOL for thermal temperature monitoring
(Range of variation, absolute boundaries)
- ✓ Consistency / Soft OOL for thermal relay monitoring (On / Off state)
- ✓ Consistency / Soft / Hard OOL for Voltage and Current monitoring

...

Note: Validity is not part of this monitoring. Telemetry status depending of other subsystem state should be covered by validity check.

8. EXAMPLE

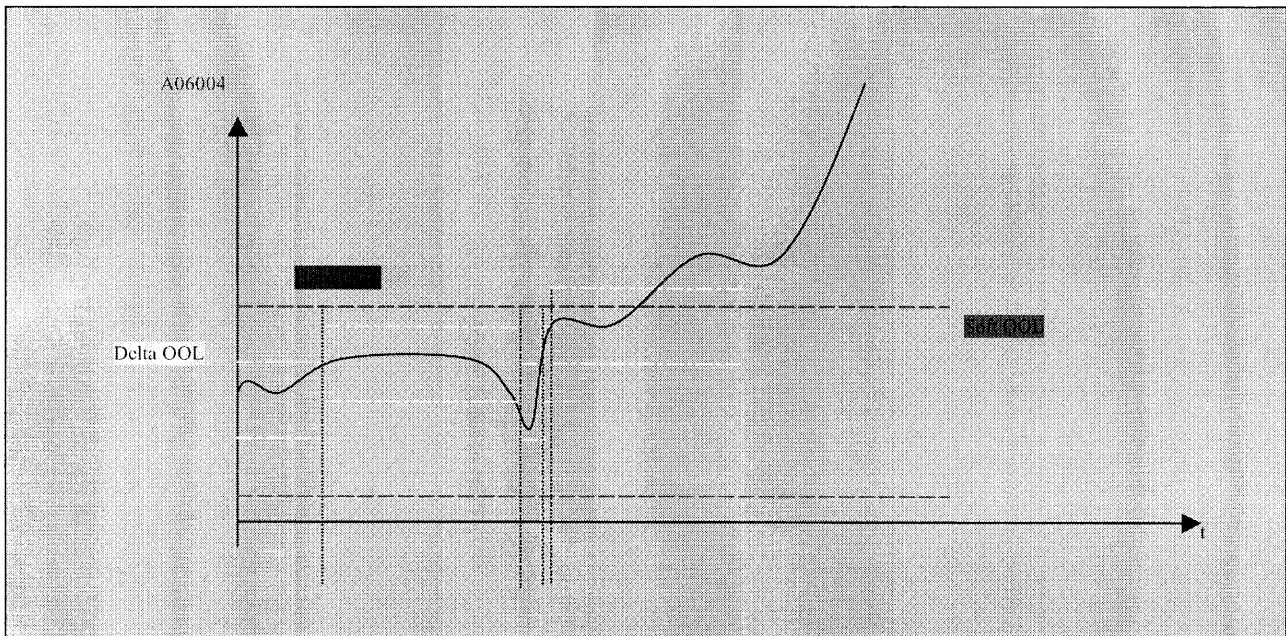
8.1 Monitoring with validity requirements, and OOL Limits

8.1.1 Description

Considering a telemetry to monitor, i.e. A06004. It is the temperature of the Star Tracker equipment. Temperature telemetry is valid only if STR 1 is On.

We want to define three OOL limits: Delta, Soft and Hard, that will be valid, only in AIT TV phase.

We illustrate the T° STR behaviour as below :



8.1.2 PCF Codification

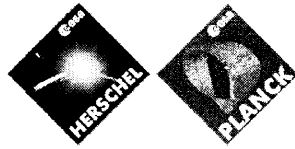
A06004 is a Raw telemetry giving STR1 temperature.

It is associated to a valid depending telemetry, called A06001, equal to 1 when STR1 is on.

Since no command is depending directly of temperature subsystem, **No status consistency** requirement is specified on this telemetry (i.e. no command stage verification can be present)

So, PCF file structure is :

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
PCF_NAME	PCF_DESCR						PCF_VALID			PCF_NATURE					PCF_VALPAR				
A06004	Temp STR1						A06001			R					1				



Note : Grey cells are non significant in our case. See [RD2] for details.

8.1.3 OCF Codification

First of all, value is considered valid, only when checked twice (We assume that is required, due to noise phenomenon).

Then, if A06004 is associated to a calibration curve, value will be interpreted as an engineering (C)

We know that A06004 will be defined with 3 checks : Delta, Soft, and Hard OOL.

Delta, low and high limits value will be interpreted in definition file as Real value.

So, OCF file structure will be :

1	2	3	4	5
OCF_NAME	OCF_NBCHCK	OCF_NBOOL	OCF_INTER	OCF_CODIN
A06004	2	3	C	R

8.1.4 OCP Codification

For delta OOL, A06004 is monitored with 10% delta tolerance

For Soft OLL, A06004 is monitored with an absolute Low/High limits of $-10/+65^{\circ}\text{C}$

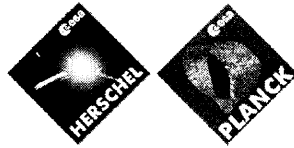
For Hard OOL, A06004 is monitored with a critical boundary temperature of $-12/+70^{\circ}\text{C}$

A synthetic parameter represents the AIT current phase. We assume that a AIT TV phase corresponds to 3.

D00000 = 3 will be therefore the condition to check these limits.

So, OCP file structure will be :

1	2	3	4	5	6	7
OCP_NAME	OCP_POS	OCP_TYPE	OCP_LVALU	OCP_HVALU	OCP_RLCHK	OCP_VALPAR
A06004	1	D		5	D00000	3
A06004	2	S	-10	65	D00000	3
A06004	3	H	-12	70	D00000	3



8.2 Consistency check monitoring and Command verification stages

8.2.1 Description

Monitoring a relay status is basically the case of a command/control link.
When sending 'On' command, we expect the relay to be closed (and open when we send the 'Off' command).

In order to achieve this logical monitoring, we consider furthermore in our example, that command is critical and that must therefore be set as hazardous in command definition file.

As a complementary condition, we define a pre-transmission verification on the 'On' command, that requires another equipment to be in a specific mode to be valid.

8.2.2 CCF Codification

TC_0000 is the command that close the relay
TC_0001 is the command that open the relay
There are both critical and must be set with **Hazardous flag**

So, CCF file structure is :

1	2	3	4	5	6	7	8	9	10	11	12	13
CCF_NAME	CCF_DESCR		CCF_CRITICAL									
TC_C0000	Command On			Y								
TC_C0001	Command Off			Y								

So, in HPSDB :
in the TC Packet menu =>G90 the « isForbidden » option is set to YES

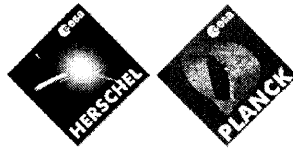
8.2.3 PCF Codification

Status relay parameter is C00000, it is a Raw telemetry, with no calibrated curve associated.
It is **status consistency checked**, and it is valid when C00001 (Safety relay for instance) is equal to 1.

So, PCF file structure is :

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
PCF_NAME	PCF_DESCR					PCF_VALID			PCF_NATURE			PCF_USCON		PCF_VALPAR				
C00000	Relay status					C00001			R			Y			1			

So, in HPSDB :
in the TC Packet menu =>Comm. Verif. Stage is associated to a command verification number created in the following CVP chapter



8.2.4 PTV codification

We define TC_0000 to be sent valid only if another equipment is in mode 'AUTO', which is corresponding to a Raw parameter M00002 equal to 2 (for instance)

So, PTV file structure is :

1	2	3	4
PTV_CNAME	PTV_PARNAM	PTV_INTER	PTV_VAL
TC_C0000	M00002	R	2

So, in HPSDB :

TBD

8.2.5 CVP codification

The command stage verification '1' is declared associated to TC_C0000 command
This stage is a **Command type** stage (not a sequence)

The command stage verification '2' is declared associated to TC_C0001 command
This stage is a **Command type** stage (not a sequence)

So CVP structure file is :

1	2	3
CVP_TASK	CVP_TYPE	CVP_CVSID
TC_C0000	C	1
TC_C0001	C	2

So, in HPSDB :

in the Command Verification menu => create 2 command verification items (Source = Expression and Stage type = Application Acceptance) and link each of them to TC_C0000 and TC_C0001

8.2.6 CVS codification

We now define the stage '1' & '2', that we choose as **'Completion of execution' type**, which means that we wait an on board acceptance and an on board execution before evaluating command stage.

Then, stages are verified with a monitoring parameter, that is a telemetry (C00000)
These stages are therefore flag as **V** type verification.

A delta time after completion is program, in order to integrate a system characteristic, that gives a small delay before closing relay. We fix it as a **1s after release time**.

Finally, we check expected value with a **32s sampling interval** in order to be compliant with a cycling house keeping packet giving the relay status.

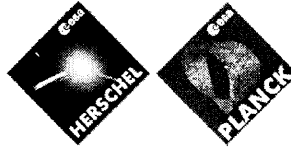


So, CVS file structure is :

1	2	3	4	5
CVS_ID	CVS_TYPE	CVS_SOURCE	CVS_START	CVS_INTERVAL
1	C	V	1	32
2	C	V	1	32

So, in HPSDB :

in the Command Verification menu => create 2 command verification items (Source = Expression and Stage type = Application Acceptance) and link each of them to TC_C0000 and TC_C0001 and Dela Time=1 and Interval=32



8.2.7 CVE codification

The stage verification '1' & '2' are now detailed with the expected values associated to the C00000 parameter.

We will interpret telemetry as a Raw value (0=Off and 1=On)

In our case, we expect '1' when sending the 'On' command, and '0' when sending the 'Off' command.

We do not accept tolerance on 0/1 (On/Off) integer value.

We want the [redacted] associated to C00000 to be updated in order to be coherent with last changes.

So CVE file structure is :

1	2	3	4	5	6
CVE_CVSID	CVE_PARNAM	CVE_INTER	CVE_VAL	CVE_TOL	CVE_CHECK
1	C00000	R	1	0	
1	C00000	R	0	0	