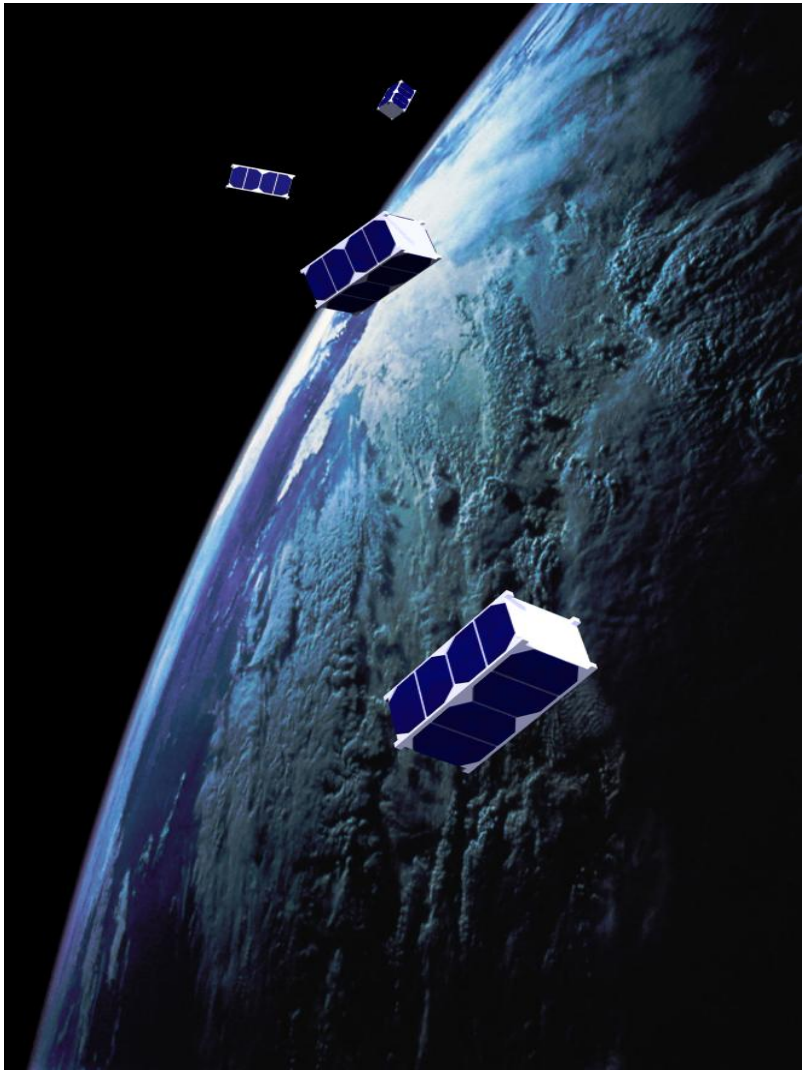
QB50

PDR Procedures



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5th QB50 Workshop
29 Jan 2019
Rhode-Saint-Genèse, Belgium

PDR Procedure Overview

- PDR Procedure – will be available on the QB50 website by 1 Feb 2013
- Each CubeSat team – responsible for their own PDR
- Independent reviewer – at least 1 external
- Summary of PDR sent to VKI – template provided
  - QB50 PDR Summary Report
  - Compliancy Table – an Excel file

  } 29 March 2013

- VKI will contact CubeSat teams re: non-compliancy report – April 2013
- PDR evaluation informed to CubeSat teams – May 2013

PDR Summary Report

- Template provided – 8 sections

CubeSat name / number	*BE05 QARMAN*		
Lead institute	*von Karman Institute (VKI)*		
Contact person(s)	*Isil Sakraker*	*Isil.sakraker@vki.ac.be*	*02 359 9423*
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	Gilles Bailet	*Gilles.bailet@vki.ac.be*	*02 359 9423*
Other institute(s)	*University of Liege – for system integration* *University of Stuttgart – for payload design and integration* *Astrium SAS – for ablative TPS material and characterization*		
CubeSat unit	*3U*		
Science payload	*N/A or Set #1 – INMS*		
Other payload	*Thermal protection system (TPS)*		
Ground station	*Located at VKI (to be built)*		
Independent Reviewer	Name	Signature	Date signed / Contact info

PDR Summary Report

1) Spacecraft Design Overview

Subsystem	Description
Structural	- *ISIS 3-Unit CubeSat structure*
ADCS	- *3 magnetorquers (GomSpace)* - *2 reaction wheels (designed in house)* - *1 startracker (Sinclair Interplanetary)*
EPS	- *3U CubeSat EPS (Clyde Space)*
OBC / OBDH	- *Pumpkin CubeSat OBC*
TT&C	
Thermal	- *Passive control (thermal tapes)*

- Provide layout of spacecraft design – interconnects of power and data lines

PDR Summary Report

2) Payload Design Overview

- page limit – 1
- no template provided
- specific to each CubeSat

PDR Summary Report

3) Spacecraft Modes of Operation

Spacecraft Mode	Description
Safe mode	*This mode is intended to keep the satellite alive. Only the essential components are ON all the time– such as the OBC, power board and VHF receiver. Transmitter is turned ON occasionally. Has uncontrolled attitude.*
Recovery / De-tumble mode	*This mode is used to de-tumble the spacecraft after ejection from the deployment dispenser as well as to recover it from any spin-ups. In addition to the essential components that are ON all the time, the ADCS is also operational during this mode. Any other device could be turned ON by ground command.*
Payload operation mode	
Spacecraft mode x	

PDR Summary Report

4.1) Mass Budget

Subsystem	Mass (g)	Contingency (g)	Mass with contingency (g)	Fraction (%)
Structural	*800*	*50*	*850*	*33.1*
ADCS	*150*	*20*	*170*	*6.6*
EPS	*100*	*10*	*110*	*4.2*
OBC / OBDH	*400*	*60*	*460*	*17.9*
TT&C	*150*	*40*	*190*	*7.4*
Thermal	*50*	*10*	*60*	*2.3*
Payload	*550*	*70*	*620*	*24.1*
Integration	*100*	*10*	*110*	*4.3*
Total	*2300*	*270*	*2570*	*100*
Target mass			*3000*	
Mass margin			***430 (Target mass– Total mass with contingency)***	***14.3% (Target mass– Total mass with contingency) / Target mass***

PDR Summary Report

4.2) Power Budget

Load	Power consumption (W)	Number of Units On	Average Duty Cycle by Mode (%) Safe mode	Recovery mode	Payload Operation mode	Spacecraft mode X	
OBC	0.450	1	100	100	100		
VHF Rx	0.250	1	100	100	100		
S-band Tx	2	1	3	3	3		
Reaction wheels	0.150	3	0	20	20		
Power board	0.500	1	100	100	100		
Camera	0.100	2	0	0	20		
Sum loads (W)			1.26	1.29	1.31		
Efficiency			0.80	0.80	0.80		
Power consumed (W)			1.58	1.61	1.64		
Power generated (W)			2	2	2		
Power margin			**21%**	**19.5%**	**18%**		

PDR Summary Report

5) Project Plans and Schedule

Major tasks	Responsibility	Start date	Expected end date

- Provide Gantt chart

PDR Summary Report

6) Comments by Independent Reviewer

- page limit – 1
- all the reviewers comments should be included

7) References and Published Papers / Presentations

8) Appendices

- can include all supporting documents
- detailed designs of each subsystem
- calculations for different budgets

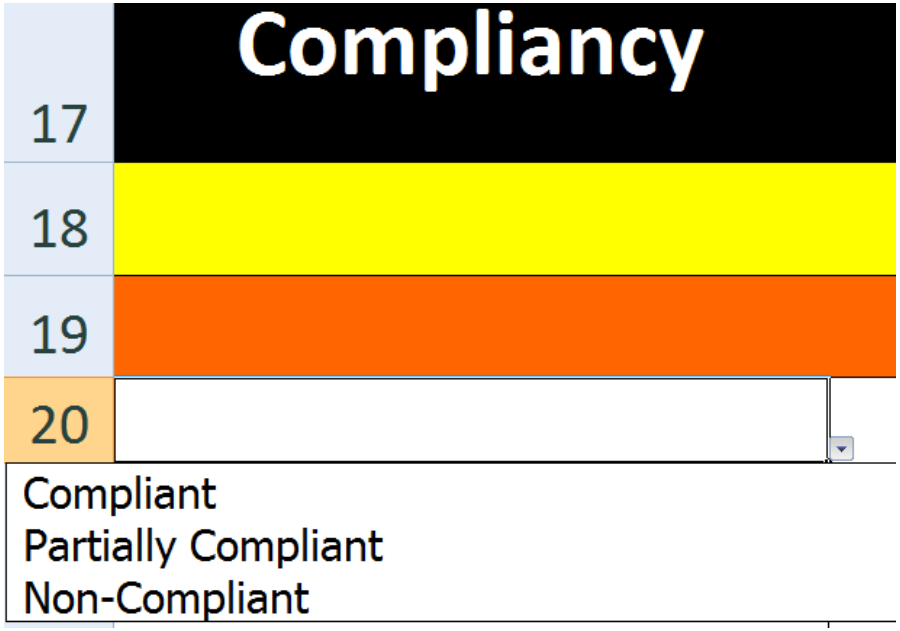
Compliancy Table Template

- Excel file – template provided

Legend
Shall be compliant by PDR
Shall be compliant by CDR
Shall be compliant by FRR

Requirement Number	Requirement Text	Compliancy	Verification Method	Action / Intent	Date
CubeSat System Requirements					
Structural Subsystem					
QB50-SYS-1.1.1	CubeSats dimensions shall be as shown in Table 1				
QB50-SYS-1.1.2	In launch configuration the CubeSat shall fit entirely within the extended volume dimensions shown in Figure 1 for a 2U CubeSat or Figure 2 for a 3U CubeSat, including any protrusions.				
QB50-SYS-1.1.3	CubeSat mass shall be no greater than that shown in Table 2 .				
QB50-SYS-1.1.4	The CubeSat centre of gravity shall be located within a sphere of 20 mm diameter, centred on the CubeSat geometric centre.				

Compliancy Column Options



Examples

Requirement Number	Requirement Text	Compliancy	Verification Method	Action / Intent	Date
CubeSat System Requirements					
Structural Subsystem					
QB50-SYS-x.x.x		*Compliant*	*By analysis (structural FEA)*		
QB50-SYS-x.x.x		*Non Compliant*	*By design*	*Will comply; Defer till CDR*	
QB50-SYS-x.x.x		*Partially Compliant*	*By analysis (simulation)*	*Will comply; Defer till FRR*	
QB50-SYS-x.x.x		*Compliant*	*By flight heritage (CanX-2, 2008)*		

Compliancy Table

- Organized by chapters of System Requirements document
  - CubeSat System
  - Environmental Testing
  - Qualification and Acceptance Testing
  - Deployment System
  - Science Payload
- Colour coded to indicate the PDR necessary requirements
- Certain requirements are still TBC and TBD
  - in the process of maturing the science payload design
  - will be frozen before CDR of the CubeSats

Conclusion

- Aim is to have a simple yet efficient PDR
- PDR Summary Report
- Compliancy Table
- Contact for any questions about PDR procedure

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Thank you for your attention!