

**CanSat Competition  
PDR and CDR  
Guide**

**2007**

This years competition will do away with the design document. Instead, each team will hold a PDR and CDR with members of the competition committee attending in person, video conference, or telecon. The PDR is to be no more than 1.5 hours in duration. The CDR is to be no more than 3 hours in duration. Each team will be assigned a mentor from the competition committee. The date and time of the PDR and CDR will be coordinated through the mentor to make sure there are at least three committee mentors present for the PDR and CDR. The PDR material must be submitted one week prior to the meeting.

The purpose of holding the PDR and CDR with members of the competition committee members is to allow the committee members to be more interactive with the teams in understanding the progress and direction of the teams. Committee members will not provide technical support will provide guidance to help the teams be more successful.

It is highly suggested that each team follow the outlines for the PDR and CDR described in this document. The PDR and CDR are scored and part of the overall scoring.

## ***Preliminary Design Review (PDR)***

A preliminary Design Review (PDR) that is to last 1 to 1 ½ hours will be prepared and presented by each team. The purpose of the PDR is for the team to

- present an understanding of the competition requirements
- present a preliminary design that discusses how the competition requirements will be met and verified
- present a reasonable understanding of schedule and cost
- provide an opportunity to receive feedback on the Cansat design and development

The PDR shall be hosted at a location designated by the team and attended via personal appearance, teleconference, or video conference by the Cansat committee team mentor and designated judges. The PDR shall be prepared according to the outline provided below. Teams shall submit PDR packages one (1) week prior to the presentation in order to allow judges time to review the material and prepare questions, comments, and concerns. Data packages shall be submitted electronically to the team mentor in Microsoft PowerPoint (PPT) or PDF format.

Teams should be remembered that all information presented at the PDR is assumed to be preliminary. It is understood that during fabrication and testing of the Cansat design changes may be implemented.

### ***PDR Outline***

The following outline for the PDR is to be used by each Cansat team. Following this outline is important to ensure fair and equal scoring by the reviewers of each presentation by providing standard expectations as to what is presented by each team. The outline also provides the team with a list of the information that is expected to be presented.

Wherever possible, simple diagrams and drawings should be used to convey concepts and design details.

#### ***I. Introduction***

The introduction section shall include

- *Team roster and roles* – the team roster and roles slide(s) shall identify the team members (including academic year), roles of each team member, and academic or industry advisors to the team (including any Cansat appointed mentors).
- *Presentation outline* – the presentation outline shall provide an overview of the presentation including approximate times and/or durations of each major section.

#### ***II. Cansat Overview***

The Cansat overview section is to provide an overview of systems level attributes of the Cansat design and development. The overview section shall include

- *Requirements overview* – the requirements overview section shall identify all design, development, and performance requirements; whether levied by the Cansat competition or internally. Requirements shall be explicitly defined so as to demonstrate an understanding of requirements. Identification of requirements flow down for each requirement to major subsystems shall be included.

- Design overview – the design overview section shall provide a high-level overview of the Cansat (and ground system) design and operation. The overview should include a high-level functional block diagram of the Cansat system. This diagram shall illustrate the major components of each subsystem, as well as, interconnections between each subsystem. Details of the design and operations should be addressed in appropriate subsystem sections of the presentation.

### ***III.Mechanical/Structural Overview***

The mechanical/structural overview section shall present the preliminary design of the Cansat structure, materials, mass, and recovery system. The mechanical overview shall present

- *Design considerations and requirements* – design considerations and/or requirements driving the mechanical/structural design of the Cansat should be presented.
- *Results of Preliminary Design/Analysis* - at a high level, explain the various designs considered for the mechanical subsystem. Explain the advantages and disadvantages of those designs supporting each design consideration with preliminary analysis, where appropriate.
- *Mechanical/structural layout* – the preliminary design of the mechanical/structural system layout of the Cansat shall be presented. This should include drawings of the structure and component layout, and a list of materials and component selections shall be included.
- *Preliminary mass budget* – the preliminary mass budget shall include allocation of masses to the various subsystems and/or components in a tabular form.
- *Recovery system overview and testing* – an overview of the recovery system is presented. The results of trade studies and/or analyses that led to the preliminary design of the recovery system should be presented. A summary of the planned testing methodologies and required facilities and equipment should be included.

### ***IV.Electrical Overview***

The electrical system overview shall present the preliminary design of the Cansat electrical, power, and communications system. The electrical system overview shall include

- *Design considerations and requirements* – a list of the design considerations and/or requirements driving the development of the Cansat electrical subsystem shall be presented.
- *Electrical system block diagram overview* – a high-level description and diagrams(s) of the electrical system shall be provided. These diagrams shall define major components of the electrical system with identification of component connections. Diagrams should be accompanied by a list of components selected.
- *Power system design overview* – the power system overview shall describe preliminary the design of the power system. Included in this discussion should be results of trade studies or analyses that resulted in the preliminary design of the power system.
- *Power budget* – a preliminary power budget shall be provided. The power budget shall list the power consumption/provided to/by each subsystem and/or component and margin allocations.

- *Communication system overview* – Shall provide at a minimum, the communications methodology, gross definition of data to be transmitted/received, (including bandwidth requirements), and best estimate of frequency selection.
- *Processor selection* – any processor(s) being utilized shall be listed. The results of trade studies or analyses resulting in the selection of the processor(s) shall be presented. A summary of data rates and expected processor loading should be included. NOTE: It is possible this element is included in the "flight" software section rather than the electrical section.
- *Sensor selection* – the sensor selection section shall list the sensors selected for the Cansat, how each sensor will be utilized, and the results of any trade studies or analyses that led to the selection of those sensors.

## **V. "Flight" Software Overview**

The "flight" software overview shall present the preliminary design of the Cansat software that operates on hardware located in the Cansat (hence, flight software). The flight software overview shall include

- *Design considerations and requirements* – a list of the design considerations and/or requirements driving the development of the Cansat flight software shall be presented.
- *Flight software overview* – the flight software overview shall include a description of the software being implemented, programming language(s), development environment(s), data rates and processor loading(s). A high-level block diagram of the flight software should be presented. Results of trade studies or analyses leading to the preliminary design should be presented.
- *Processor selection* – any processor(s) being utilized shall be listed. The results of trade studies or analyses resulting in the selection of the processor(s) shall be presented. A summary of data rates and expected processor loading should be included. NOTE: It is possible this element is included in the electrical section rather than the "flight" software section.

## **VI. Integration and Test Overview**

The integration and test overview section discusses the system level integration and testing of the Cansat. This section shall include discussions of

- *Design considerations and requirements* – a list of the design considerations and/or requirements driving the development of the Cansat integration and test shall be presented.
- *Systems integration and testing* – a description of the methods, facilities, and testing to be utilized to integrate the various subsystems and test the integrated Cansat shall be presented.

## **VII. Ground System Overview**

The ground system overview shall present the preliminary design of the ground system. This includes any ground hardware and software utilized during operations of the Cansat. The ground system overview section shall include

- *Design considerations and requirements* – a list of the design considerations and/or requirements driving the development of the Cansat ground system integration and test shall be presented.
- *Ground system architecture* – an overview of the ground system including hardware and software selection. A diagram and list of the major ground system components shall be presented.

- *Ground hardware selection* – a summary of the ground hardware components and results of analyses and/or trade studies leading to the selection of the hardware.
- *Ground software overview* – a summary of ground system software and results of analyses and/or trade studies leading to the selection of the ground software should be presented. For developed software, the programming language(s) and development environment(s) shall be discussed. Ground system software should include any software necessary for data analysis.

### ***VIII.Mission Operations***

The mission operations section discusses operation of the Cansat in order to achieve the mission objectives. This section shall discuss

- *Concept of operations* – an overview of the launch day sequence of events shall be presented. A mission time-line presented as a table or diagram is recommended.
- *Data analysis* – a discussion of how data analysis will be performed shall be presented. This should include a list of data to be analyzed and hardware and/or software requirements for data analysis.

### ***IX.Cost Estimates***

The cost section shall present preliminary estimates of component, manufacturing, and service costs. Costs shall be summarized for both the Cansat and ground segment.

### ***X.Schedule Overview***

The schedule overview section shall present the Cansat development schedule. The schedule shall include a list of major milestones, estimates of completion dates, and required resources. For milestones completed by PDR, actual versus estimated schedule performance shall be presented. It is recommended that information be presented graphically (Gantt charts, etc.) or in a table.

### ***XI.Summary***

## ***Critical Design Review***

A Critical Design Review (CDR) that is to last 2 to 3 hours will be prepared and presented by each team. The purpose of the CDR is for the team to

- present details of the cansat design
- present requirement compliance
- present revised cost and schedule estimates
- provide an opportunity to receive feedback on the cansat design and development

The CDR shall be hosted at a location designated by the team and attended via personal appearance, teleconference, or video conference by the Cansat committee team mentor and designated judges. The CDR shall be prepared according to the outline provided below. Teams shall submit CDR packages one (1) week prior to the presentation in order to allow judges time to review the material and prepare questions, comments, and concerns. Data packages shall be submitted electronically to the team mentor in Microsoft PowerPoint (PPT) or PDF format.

It should not be assumed that the CDR presentation will be reviewed by the same people who reviewed the PDR. Therefore, it is suggested that pertinent results and information from PDR should be re-stated as required. However, the CDR is to detail the "final" design of the Cansat, and as such, material should not recount all trade studies, etc. from PDR. It should also be noted that even though the CDR present the "final" design, changes necessary based on integration and testing of the Cansat following CDR are permissible and should be addressed during the final presentation.

## ***CDR Outline***

### ***I. Introduction***

The introduction section shall include

- *Team roster and roles* – the team roster and roles slide(s) shall identify the team members (including academic year), roles of each team member, and academic or industry advisors to the team (including any Cansat appointed mentors).
- *Presentation outline* – the presentation outline shall provide an overview of the presentation including approximate times and/or durations of each major section.

### ***II. Cansat Overview***

The Cansat overview section is to provide an overview of the Cansat design and development. The overview section shall include

- *Requirements overview* – the requirements overview section shall identify all design, development, and performance requirements (whether levied by the Cansat competition or internally) and flow-down of requirements to the subsystems. A statement related to how the requirement has been verified shall also be included. For requirements that have not been verified by CDR, a statement as to when and how the requirement will be verified should be made.
- *Design overview* – the design overview section shall provide a high-level overview of the Cansat (and ground system) design and operation. The overview should include a high-level functional block diagram of the Cansat system. This diagram shall illustrate the major components of each subsystem,

as well as, interconnections between each subsystem. Details of the design and operations should be addressed in appropriate subsystem sections of the presentation.

### **III. Mechanical/Structural Overview**

The mechanical/structural overview section shall present the final design of the Cansat structure, materials, mass, and recovery system. The mechanical overview shall present

- *Design considerations and requirements* – design considerations and/or requirements driving the mechanical/structural design of the Cansat should be presented.
- *Summary of changes since PDR* – a summary of changes made to the design since the PDR shall be presented. Pertinent information and analysis results related to changes should be discussed.
- *Mechanical layout* – the mechanical layout of the Cansat shall be presented. This should include drawings of the structure and component layout and a list of materials and component selections shall be included.
- *Mass budget* – the mass budget shall include allocation of masses to the various subsystems and/or components in a tabular form.
- *Mechanical/structural subsystem testing* – an overview mechanical/structural subsystem testing shall be presented. This should include an overview of the test methodologies, equipment, and facilities, as well as, presentation of the results of completed tests.
- *Recovery system overview and testing* – an overview of the recovery system is presented. The results of trade studies and/or analyses that led to the preliminary design of the recovery system should be presented. A summary of the planned testing methodologies and required facilities and equipment should be included.
- *Work to be completed* – a summary of work remaining to be completed for the mechanical/structural subsystem shall be presented.

### **IV. Electrical Overview**

The electrical system overview shall present the final design of the Cansat electrical, power, and communications system. The electrical system overview shall include

- *Design considerations and requirements* – a list of the design considerations and/or requirements driving the development of the Cansat electrical subsystem shall be presented.
- *Summary of changes since PDR* – a summary of changes made to the design since the PDR shall be presented. Pertinent information and analysis results related to changes should be discussed.
- *Electrical system block diagram overview* – a high-level description and drawing(s) of the electrical system shall be provided. These diagrams shall define major components of the electrical system with identification of component connections. Diagrams should be accompanied by a list of components selected.
- *Power system design* – the power system overview shall describe the final design of the power system. Included in this discussion should be a functional diagram of the power system with major components identified.



- *Power budget* – a power budget shall be provided. The power budget shall list the power consumption/provided to/by each subsystem and/or component and margin allocations.
- *Communication system overview* – shall present the final design of the communications system onboard the Cansat. Transmit/receive frequencies shall be established. The overview shall also provide bandwidth and data rate requirements.
- *Sensor selection* – the sensor selection section shall list the sensors selected for the Cansat and how each sensor will be utilized.
- *Electrical subsystem testing* – an overview of how the electrical subsystem will be tested shall be presented. This description shall include methodologies and required equipment or facilities. This should also include results of tests completed.
- *Work to be completed* – a summary of work remaining to be completed for the electrical subsystem shall be presented.

## **V. "Flight" Software**

The "flight" software overview shall present the final design of the Cansat software that operates on hardware located in the Cansat. The flight software overview shall include

- *Design considerations and requirements* – a list of the design considerations and/or requirements driving the development of the Cansat integration and test shall be presented.
- *Summary of changes since PDR* – a summary of changes made to the design since the PDR shall be presented. Pertinent information and analysis results related to changes should be discussed.
- *Flight software overview* – the flight software overview shall include a description of the software being implemented, programming language(s), development environment(s), data rates and processor loading(s). A high-level block diagram of the flight software should be presented. Results of relevant analyses should also be presented.
- *Flight software testing* – an overview of how the flight software will be tested shall be presented. This description shall include methodologies and required equipment or facilities.
- *Work to be completed* – a summary of work remaining to be completed for the flight software subsystem shall be presented.

## **VI. Integration and Test Overview**

The integration and test overview section discusses the system level integration and testing of the Cansat. This section shall include discussions of

- *Design considerations and requirements* – a list of the design considerations and/or requirements driving the development of the Cansat flight software shall be presented.
- *Summary of changes since PDR* – a summary of changes made to the integration and test since the PDR shall be presented. Pertinent information and analysis results related to changes should be discussed.
- *Systems integration and testing* – a description of the methods, facilities, and testing to be utilized to integrate the various subsystems and test the integrated Cansat shall be presented.

- *Work to be completed* – a summary of work remaining to be completed for the integration and test shall be presented.

## **VII. Ground System**

The ground system overview shall present the design of the ground system. This includes any ground hardware and software utilized during operations of the Cansat. The ground system overview section shall include

- *Design considerations and requirements* – a list of the design considerations and/or requirements driving the development of the Cansat ground system integration and test shall be presented.
- *Summary of changes since PDR* – a summary of changes made to the integration and test since the PDR shall be presented. Pertinent information and analysis results related to changes should be discussed.
- *Ground system architecture* – an overview of the ground system including hardware and software selection. A diagram and list of the major ground system components shall be presented.
- *Ground hardware selection* – a summary of the ground hardware components and results of analyses and/or trade studies leading to the selection of the hardware.
- *Ground software overview* – a summary of ground system should be presented. For developed software, the programming language(s) and development environment(s) shall be discussed. Ground system software should include any software necessary for data analysis.
- *Ground system testing* – an overview of how the ground system hardware and software will be tested shall be presented. This description shall include methodologies and required equipment or facilities.
- *Work to be completed* – a summary of work remaining to be completed for the ground system subsystem shall be presented.

## **VIII. Mission Operations**

The mission operations section discusses operation of the Cansat in order to achieve the mission objectives. This section shall discuss

- *Design considerations and requirements* – a list of the design considerations and/or requirements driving the development of the Cansat mission operations shall be presented.
- *Summary of changes since PDR* – a summary of changes made to the integration and test since the PDR shall be presented. Pertinent information and analysis results related to changes should be discussed.
- *Concept of operations* – an overview of the launch day sequence of events shall be presented. A mission time-line presented as a table or diagram is recommended.
- *Launch site roles and responsibilities* – a revised list of launch day roles and responsibilities shall be presented.
- *Contingency operations* – a discussion of contingency preparedness shall be presented. This shall include a revised list contingencies to be prepared for and how each will be addressed at the launch site.
- *Data analysis* – a discussion of how data analysis will be performed shall be presented. This should include a list of data to be analyzed and hardware and/or software requirements for data analysis.

- *Work to be completed* – a summary of work remaining to be completed for the mission operations shall be presented.

#### ***IX. Cost summary***

The cost section shall present a summary of Cansat budget. This should include estimates/actual costs of components, manufacturing, and services. Costs shall be summarized for both the Cansat and ground segment.

#### ***X. Schedule***

The schedule section shall present the Cansat development schedule. The schedule shall include a list of all major milestones, estimates and actual completion dates, and required resources. It is recommended that information be presented graphically (Gantt charts, etc.) or in a table.

#### ***XI. Summary***