IV. TÜRKSAT Model Satellite Competition

Guide

Mission:

Telecommand Package

3 Axis Gyro Entegration & Simulation

Version 1.1

Sept 17-22, 2019

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Versions			
Version	**Date**	**Statement**	**Changes**
1.0	02.01.2018	First Version	-
1.1	15.01.2019		Telecommand Package 3 Axis Gyro Entegration & Simulation Dimension Disqualification Guidelines Weather Conditions (Flight Plan B)

1. Introduction

1.1 General Information

TÜRKSAT Model Satellite Competition is a design-build-flight competition. The T-MUY provides teams with an opportunity to experience process from design to beginning of active mission of an aerospace system. The T-MUY competition is planned to reflect an aerospace project on a small scale and includes all aspects of an aerospace project, from design to production and post-mission review. The competition is designed to reflect various aspects of real missions such as addressing telemetry and communication requirements, provide autonomous structure and developing an interdisciplinary working system.

T-MUY aims to provide undergraduate and graduate students in engineering field with the opportunity to transfer knowledge from theory to practice and to acquiring the ability to work interdisciplinary. Additionally, It is aimed that the students will have the opportunity to share their experiences with other university teams and to communicate with the institution, companies, experts and engineers operating in the sector.

1.2 General Provision

The announcements related to the competition are made via the website www.modeluydu.org. No another announcement will be made for each team and the announcements published on the website will be a notification. Participation in the competition as a team is mandatory. Individual applications will not be considered. During the competition, any communication activity will be implemented by using alternative channels via TÜRKSAT.

The teams that their applications are accepted and announced can make sponsorship negotiation for their needs and they can receive financial assistance for this purpose. TÜRKSAT will cover the needs such as accommodation, intracity transportation, food. The participants do not make any unauthorized statement to the press about the competition. TÜRKSAT reserves the right to change the prizes, rules, number of participating teams or to cancel the competition with giving reason.

1.3 Mission Overview

In the TÜRKSAT Model Satellite Competition, Model Satellite represents the payload that can land in a planet's atmosphere, collect data from its sensors, reflect the collected data on an interface, record image and make instant data exchanges.

Model Satellite shall be designed and produced in a way that consists of two parts, science payload and the container. The container is to protect science payload that performs desired tasks.

The Model Satellite (Container + Science Payload) will be raised above 500 meters and will be released from a altitude of approximately 500 meters. The Model Satellite will descend to 400 meters with the passive landing system. At a height of 400 meters the container and the science payload will be released. After release, the atmosphere will continue to descend separately.(The determined altitude may vary with the effect of adverse weather conditions on the flight day.)

The Science Payload will send the video image and telemetry package every second (1 Hz) during the entire flight (form the moment run to landed) to the competitor's own ground station. Video and Telemetry data will also be stored in a memory on the Science Payload. The time dependent graphs of telemetry data will simultaneously be plotted on the ground station. Video image will be watched on the ground station. Telemetry data and video image will also be recorded to the ground station. When the mission is completed, whole data recorded in the ground station software will be handed over officer.

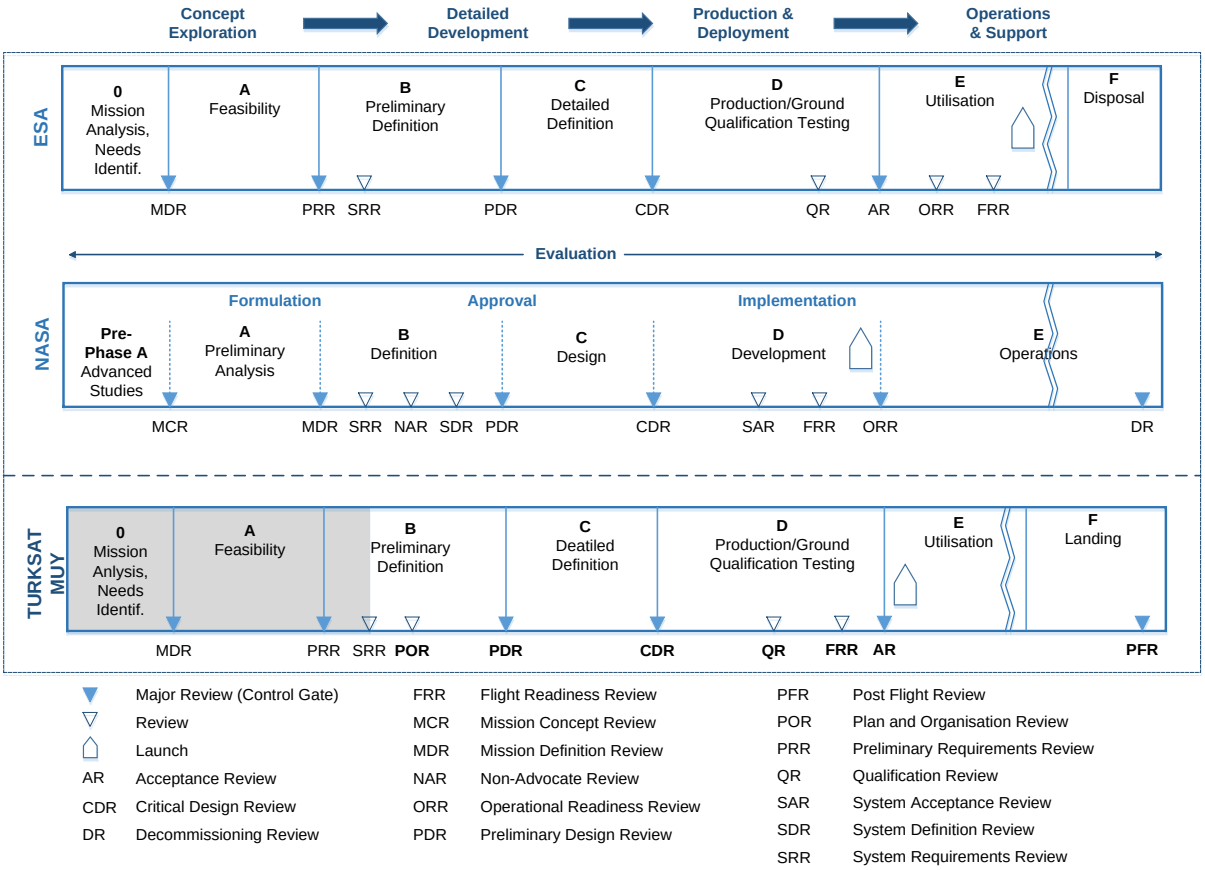
After the Science Payload has landed, it will continue to the data transfer for 1 minute and at the end of 1 minute, the data transmission will be terminated automatically and give an audible signal for recovery.

1.4 Competition Description

The competition is in seven phases.

First phase is the application and acceptance phase. The teams formed as stated in the team structure section must be submitted by February 28, 2019. Accepted teams will be announced on March 4, 2019. Application details are indicated in the competition application section.

Table 1 T-MUY Phases



▼	Major Review (Control Gate)	FRR	Flight Readiness Review	PFR	Post Flight Review
▽	Review	MCR	Mission Concept Review	POR	Plan and Organisation Review
⌂	Launch	MDR	Mission Definition Review	PRR	Preliminary Requirements Review
AR	Acceptance Review	NAR	Non-Advocate Review	QR	Qualification Review
CDR	Critical Design Review	ORR	Operational Readiness Review	SAR	System Acceptance Review
DR	Decommissioning Review	PDR	Preliminary Design Review	SDR	System Definition Review
				SRR	System Requirements Review

Table 1 shows the phases of TURKSAT Model Satellite Contest. For comparison, the phases that ESA and NASA follow for a standard satellite project are also included in the table.

The part indicated in gray is the preparation phases of TÜRKSAT Inc. until the announcement of the competition. Then, the following steps are;

I. POR: The project plan was formed and the team organization was determined,
II. PDR: The preliminary design are made, the plans and procedures of the tests to be carried out at the equipment, subsystem and system level are reported,
III. CDR: The phase in which includes details of design to be produced, testing and reporting equipment and subsystems,
IV. QR: The system level tests are performed and reported for the installation of the system,
V. FRR: The Model Satellite is physically controlled to be sure that is ready to flight,
VI. AR + Flight: Delivery of the model satellite to the competition commission and its flight,
VII. PFR: The phase after the flight is examined and the experiences obtained are reported.

Second Phase; is the reporting phase of the project plan and organization chart (POR–Plan and Organization Review). Teams will complete the project plans and the task distribution of the team members in detail by the form of Gantt chart at this stage. This report shall be submitted in the format as detailed in the description.

Third Phase; is to prepare Preliminary Design Review (PDR) report. Teams shall develop their designs, prototypes, test concepts (plans and procedures for tests to be carried out on each equipment, subsystem and Model Satellite integrated and assembled) and report them using the preliminary design

review report (PDR) template provided to them. This report must be submitted in the format described in the detailed description and in the appropriate format. After the review of the prepared PDR report by the competition judge, teams will have a 25 minutes to discuss a subset of the PDR slides via teleconference. A schedule will be made available on when to present a subset of the slides. **Submit the documents early to be safe.**

Fourth Phase; is to prepare Critical Design Review (CDR) report. The teams will complete their design and start to order their components, manufacturing parts. The test results (with the implementation of the specified plans and procedures in the PDR) of equipment and subsystems will be included in this report. This report shall be submitted in the format described in the detailed description and in the appropriate format. After the review of the prepared PDR report by the competition judge, teams will have a 25 minutes to discuss a subset of the PDR slides via teleconference. A schedule will be made available on when to present a subset of the slides. A schedule will be made available on when to present a subset of the slides. **Submit the documents early to be safe.**

Fifth Phase; is that system level tests of the completed system, that is, Model Satellite which is assembled and integrated are performed and reported (QR–Qualification Review). In this phase, the teams shall merge the subsystems of the model satellites to system level and perform system level tests. This report shall be submitted in the format described in the detailed description and in the appropriate format. After reviewing the prepared QR report by the competition judge, the results of the examination will be notified to the teams by e-mail. No teleconferences will be made for the QR report. **Submit the documents early to be safe.**

Sixth Phase; is the time of the competition. One day before the competition; the teams will present the completed model satellites for the flight preparation examination to the review commission. This is the stage in which the competence to flight is controlled, the FRR - Flight Readiness Review stage. The model satellite shall be fully assembled and activated. In order to participate in the flight, model satellites must pass the flight preparation assessment.

On the day of the competition, teams will complete all their preparations and submit the model satellites to the competition commission until 10:00. The plan of the competition day is indicated in the related section.

Seventh phase; is the Post Flight Review report (PFR). The technical results obtained from the competition, the problems they experienced in the flight, the reasons for these problems, solutions to these problems and what they learned during the project in the critical term will be reported using the PFR template given to them. These reports, a day after flight, will be presented to the competition judge within 15 minutes including 10 minutes of presentation, 5 minutes to answer questions. The time schedule of the PFR presentations will be shared with the teams after the flights. Details of the PFR phase are given in the relevant section.

Team members are required to attend all stages of the competition and to participate in the competition area to receive a participation certificate and award.

The evaluation results will be created in a quantitative format and will be shared with teams by minimizing incomprehensibility and ensuring that teams can see their own shortcomings.

The competition is performed by voluntary TÜRKSAT employees who aims to share their experience with students, to learn more about the space/spacecraft projects and to provide students with the experience of communicating the process management of an organization.

Model Satellite Competition is carried out by volunteers to provide a practical training experience for teams. Volunteers devote their time to this organization to support the competition. **For this reason, please submit your reports before the deadline in accordance with the document templates and the document name; please pay attention to the style required in communication processes with the members of the organization board, mentors and referees.**

1.5 Timeline

The general outline of the competition plan is as follows. The dates to be considered for teams are highlighted in bold.

Deadline	Phase
February 4 , 2019	Announcement of Competition
February 28, 2019 - 23:59	Application Deadline
March 17, 2019 - 23:59	POR Report
April 28, 2019 - 23:59	PDR Report
July 7, 2019 - 23:59	CDR Report
July 16, 2019	Participation Documents
September 8, 2019 - 23:59	QR Report
September 17 – 22, 2019	Operation Management Control Charts
	Flight Readiness Review (FRR)
	Flight
	Presantations of PFR
	Announcement of Competition Results and Award Ceremony

1.6 Team Composition

Teams of university students (Undergraduate, Master, PhD engineering students) can participate in the competition. Teams consist of a minimum of 3 and a maximum of 6 persons. (There may be a maximum of 2 Master / PhD students in the team.)

Each team must have only one advisory faculty member (assistant professor, professor). The role of advisor is;

- Providing laboratory resources for the team, working class / room / environment and the environment for teleconferencing,
- Leading the team leader and the team,
- Delivering of documents prepared by the team to the competition committee.

The advisor should not do the followings;

- Design or suggest a design directly,
- Advise more than one team for this competition,
- Manage the operation on the day of the competition.

Each team must have a Team Leader selected from members. Missions;

- Provide coordination and knowledge transfer between the team and the advisor,
- Provide coordination with competition officials,
- Conducting the project and ensuring coordination within the team.

The competition committee will give a four-digit team number to each team.

Teams can contact via e-mail (modeluydu@turksat.com.tr) for any information about the competition rules and the organization.

1.7 Application

Applications must be completed until 28.02.2019 - 23:59 on www.modeluydu.org.

The teams whose applications have been accepted will be announced at www.modeluydu.org on 4.03.2019.

Official Documents: The documents required for the teams accepted their application are listed below. After the CDR report has been delivered, the documents must be delivered to TÜRKSAT Inc. Corporate Communications Directorate Cevizlidere Street No: 1 (Room A-8) Balgat/Ankara **until July 16, 2019 - 17: 00**.

a) 1 photo (each team member, with the name behind)
b) Student certificate (each team member)
c) Official letter (including date and number) with letterhead containing the current status of the team member and the advisor (student or staff) and indicating that the team is authorized to represent the university / unit in the competition
d) Statement of participation and recognizance completed and signed by the members of the participating team and their advisor

2. TECHNICAL REQUIREMENTS

2.1 Base Requirements

No	Requirement
1	The Model Satellite shall consist of two parts: Science Payload and Container.
2	Total mass of the Model Satellite (science payload and container) shall be 500 grams +/- 20 grams.
3	Model Satellite shall design as a cylindrical structure of 180 mm length x 80 mm diameter.
4	The container shall be designed in such a way that it will not get stuck to any place and shall be constructed confident to protect the science payload.
5	With a passive landing system, the Model Satellite (Container + Science Payload) should descend at a speed of 8-10 m / s up to a height (altitude) of 400 meters. (The determined altitude may vary with the effect of bad weather conditions on the flight day.)
6	At a height of 400 (+/- 10) meters, the container and the science payload shall be autonomously separated by a mechanism.
7	Release mechanisms shall not use pyrotechnics or chemicals.
8	After the release, the science payload shall descend at the speed of 4-6 m / s with a passive or active landing system.
9	All descent control device attachment components shall survive at least 10 G of shock.
10	All electronic equipment and mechanical components to be assembled shall be assembled and fastened using suitable equipment such as connectors, screws and high-performance adhesives.
11	Model Satellite shall be ensured to be landed non-damaged.
12	After the Model Satellite has landed, a damage check shall be carried out for broken or crumbled pieces of the system.
13	The science payload shall acquire outside temperature, air pressure, altitude, descent rate, position, battery voltage and axes data during the fligth.
14	The satellite should send the measured data continuously to the ground station every second (1 Hz) in the form of packages suitable for the given telemetry format.

No	Requirement
15	The telemetry package shall include the task time. During the task, the time data shall be preserved even if the processor restarts. (A coin battery can be used for this.)
16	The flight software shall maintain the number of packets sent and increase the number in each packet transmission starting from 1. If the processor restarts, the number of packets shall resume.
17	Telemetry data shall also be printed on an SD card in the satellite at the same time.
18	On the science payload, there should be a ground-facing camera. Camera images shall be recorded as video on an SD card during the entire flight period. The video resolution shall be at least 640x480.
19	The model satellite facing the earth shall send the video image to the ground station during the mission (from the moment the system starts working).
20	Alkaline, Ni-MH, Lithium Ion batteries can be used. (It is forbidden to use lithium polymer batteries as it is flammable.)
21	The battery to be selected shall be sufficient to operate the system for 1 hour.
22	**TELECOMMENT (v1.1):** 5-digit password information (e.g. X123C) defined for each team will be sent as telecomment at the time of flight from the ground station interface. The science payload shall save the password to the SD Card.
23	In the case of non-separation of the science payload, the command sent from the ground station shall be separated from the container.
24	The science payload shall have an on / off button. This button shall be designed to be accessible even when the science payload is inside the Container.
25	Installation of the electronic equipment shall be done by fixing the mechanical fixture. Connectors in the electronic circuit shall not be used to cause dislodgement or disconnection.
26	The Model Satellite shall continue telemetry and video broadcasting for at least 1 minute after it has been undamaged landed. The location of the satellite can be determined with the telemetry package which has location data.
27	The Model Satellite shall give an audible warning when science payload is landed.
28	Each team shall develop their own ground station software.
29	Wireless communication modules should be used to send telemetry data and image to ground station.
30	The telemetry data from the science payload shall be displayed in real time on the ground station interface.

No	Requirement
31	In ground station software, telemetry data from the science payload shall be recorded and time-dependent graphs shall be drawn in real time with the correct engineering units.
32	The video shall be monitored in real time on the ground station and recorded in the ground station.
33	The computer where the ground station software is to be operated shall have at least two hours of battery full.
34	**GYRO (v1.1.):** The gyro sensor on the science payload shall simulate the position information of the model satellite in the ground station interface on at least 1 plane(x-y) and 2 dimension. Axis Position Information is given in the appendix 5.2.
35	The parachute color of the science payload shall be red and the parachute color of the container shall be yellow.

2.2 Telemetry Format

<TEAM ID>, <PACKET NUMBER>, <MISSION TIME>, <PRESSURE>, <ALTITUDE>, <DESCENT RATE>,<TEMP>,<VOLTAGE LEVEL>, <GPS LATITUDE>,<GPS LONGITUDE>,<GPS ALTITUDE>,<SATELLİTE STATUS >,<PITCH>,<ROLL>,<YAW>,<SPIN RATE>

Telemetri Formatı Açıklamaları:

<TEAM ID>: After the application process is completed, the team numbers are given. It is a 4 digit number. The team number of each team is different from the number of the other teams.

<PACKET NUMBER>: The sequential number assigned to each telemetry packet is generated at the time of the competition and is sent to the ground station. The first package begins with 1 and continues sequentially. In the case of a restart of the processor, the packets must continue at the last remaining number.

<MISSION TIME>: It is the real time with the format Day/Month/Year, Hour/Minute/Second.

<PRESSURE>: Measured atmospheric pressure value.

<ALTITUDE>: It is the altitude of the science payload from the point where the flight begins. The altitude configuration shall be adjusted to be 0 meters from the beginning of the flight. The unit is meters.

<DESCENT RATE>: The unit is m/s.

<TEMP>: It is the sensed temperature in degrees C.

<VOLTAGE LEVEL>: It displays the power of the science payload in Volt.

<GPS LATITUDE>: It is the latitude generated by the GPS receiver.

<GPS LONGITUDE>: is the longitude generated by the GPS receiver

<GPS ALTITUDE>: is the altitude generated by the GPS receiver

<SATELLİTE STATUS>: It is meaningful information that shows the status of the satellite during the mission period. (Pending, Elevation, Model Satellite Descent, Leaving, Science Payload Descent, Rescue, etc.)

<PITCH>: It is the pitch angle in degrees.

<ROLL>: It is the rolling angle towards direction of the flight in degrees.

<YAW>: It is the yaw angle towards direction of the flight in degrees.

<SPIN RATE>: The number of turns around the roll axis during descent.

3. DELIVERABLE ITEMS

3.1 Official Documents

The documents required for the teams with positive application are listed below. After the CDR report has been delivered, the documents must be delivered to TÜRKSAT Inc. Corporate Communications Directorate Cevizlidere Street No: 1 (Room A-8) Balgat/Ankara **until July 16, 2019 - 17: 00**.

a) 1 photo (each team member, with the name behind)
b) Student certificate (each team member)
c) Official letter (including date and number) with letterhead containing the current status of the team member and the advisor (student or staff) and indicating that the team is authorized to represent the university / unit in the competition
d) Statement of participation and recognizance completed and signed by the members of the participating team and their advisor

3.2 Plan and Organization Review (POR) Report

POR is the first report of the model satellite project. During the preparation of this report; how to manage the team and how to conduct the work will be determined and a systematic structure will be established. The team structure will also be created at this stage and displayed in an organizational chart. Considerations when preparing the POR report:

- **POR Report template shared with teams must be used.**
- It shall consist of 3 parts;
  - First part of the report is cover page,
  - Second part is the organization chart,
  - Third part is the project plan calendar in Gantt Chart form.
- The report footer shall be updated with the team information.

After the POR report has been reviewed by the competition officiers, the suggestions will be made by e-mail to the teams.

Score Weight: 2%

3.3 Preliminary Design Review (PDR) Report

In PDR phase, preliminary system designs are made. Meet the performance requirements of the pre-systems designed in the Preliminary Design Review Report within the scope of the cost (program budget), work plan (schedule), risk and other system constraints; is an "interdisciplinary" review report created to decide the final detailed design. At the end of this report, one of the preliminary designs is decided. When passing to CDR phase, the details of the design are determined. Considerations when preparing the PDR report:

- An understanding of the CanSat mission requirements,
- How the technical requirements are derived system and subsystem requirements and how the team is allocated according to the design criteria,
- How to verify system, subsystem, and equipment requirements (Test, Analyze, Design Review, Inspectability),
- Explanation the operation management of the Model Satellite and its subsystems (Consept of Operation / Operational Architecture),
- Overview of preliminary designs that meet specified requirements,
- Comparison the preliminary designs and decision which one,
- Description of what to do for design (It is not necessary, although it is ideal to complete the procedures described before pre-preparation.),
- Step by step plan of testing for equipment, subsystems and system,
- The installation plan of the equipments that make up the subsystems,

- The integration plan of subsystems that form the system (Model Satellite),
- Detailed work schedule and,
- Preliminary budget plan.

After reviewing the prepared PDR report by the jury, a 25-minute presentation to the jury will be made by teleconference. After the presentation is completed, 5 minutes will be allocated for questions and answers and the juries will make suggestions. The timetable for determining the teleconference date will be shared with the teams.

Each section of the PDR Report will be scored according to the values listed in the PDR Evaluation Table.

Score Weight: 15%

3.4 Critical Design Review (CDR) Report

In the CDR phase; the detailed design of the system decided on the Preliminary Design Review Report is carried out as planned and the integration plan of the subsystems is shown. The Critical Design Review Report is a review report created to see if sub-systems productions, sub-systems and components test results, system details, cost (program budget), work plan (program schedule), interdisciplinary performance equirements within risk and other system constraints are met. Considerations when preparing the CDR report:

- Overview of task operations,
- Explanation the operation management of the Model Satellite and its subsystems (Consept of Operation / Operational Architecture),
- Detailed design and analysis results for each subsystem,
- How to verify system, subsystem, and equipment requirements (Test, Analyze, Design Review, Inspectability),
- Plans of equipment, subsystem and system level tests required for verification of requirements,
- Results of tests for equipment,
- Installation plan of sub-systems (for each subsystem),
- If done, the results of the subsystem tests,
- The integration plan of subsystems that form the system (Model Satellite),
- Test results of requirement verification (Subsystem tests must be completed),
- Updated detailed work schedule chart (Completed jobs must be specified.),
- Updated budget plan (It will include the purchase status.; pending, on the cargo, delivery, refunded etc.).

After reviewing the prepared CDR report by the jury, a 25-minute presentation to the jury will be made by teleconference. After the presentation is completed, 5 minutes will be allocated for questions and answers and the juries will make suggestions. The timetable for determining the teleconference date will be shared with the teams.

Each section of the CDR Report will be scored according to the values listed in the CDR Evaluation Table.

Score Weight: 15%

3.5 Qualification Review (QR) Report

QR is a report of Model Satellite tests at system level. In this phase, integration of subsystems is required. Thus, the Model Satellite is created. System tests shall be performed and the results shall be interpreted. System tests shall be performed and reported as specified in the QR Qualification Review Report Template published on the competition site. Considerations when preparing the QR report:

- Integration state of the Model Satellite,
- How the system level environmental impact tests are conducted and the results,

After reviewing the prepared QR report by the competition juries, the results of the examination will be notified to the teams by e-mail. There will be no teleconferences after the Qualification Review Report has been submitted. The QR Report will contribute to the total score of the competition according to the score value specified in the Contest Score Template document.

Score Weight: 8%

3.6 Operations Management Control Chart (OMC)

OMC is the checklist of the work of the teams to be used on the day of the competition. Teams should plan each job step by step on the day of the competition and assign them to the roles of the team as specified in the Operation Management Control Chart (OMC) Template published in the competition site. Considerations when preparing the OMC report:

- Works to be done step by step on the day of the competition,
- Roles for each member in the team and

After reviewing the prepared OMC report by the competition jury, the suggestions will be shared verbally with the teams at the FRR stage.

The teams should come to FRR with 2 hardcopiess from the Operation Management Check Chart. One of the copies will be given to the TÜRKSAT's officers and the other will remain on the team.

Score Weight: 2%

3.7 Post Flight Review (PFR) Report

Post Flight Review Report includes flight operations and flight results. In the presentation of the PFR Report, it is necessary to specify which of the tasks to be completed in the flight operation are successful and which ones are unsuccessful with its results and solution suggestions shall be made to prevent any further occurrence. This report must be prepared using the PFR Report template published on the contest site. Considerations when preparing the PFR report:

- An overview of the team's Model Satellite design and team's objectives of the competition,
- Comparison of planned and implemented operations management,
- Raw and processed data received from flight operation,
- Analysis and evaluation of problems (for failed mission objectives) and
- What they learn from the project.

The PFR Report will be completed by the teams after the flight takes place.

During the flight, a usb memory will be given to each team. The teams shall upload their PFR presentations to the usb memory in pdf format and deliver it to the location specified between 09:00 - 10:00 on the day of presentation. Teams who submit their report after 10:00 will lose points. This application is made for the same time period for all teams to prepare PFR reports.

Each section of the PFR Report will be scored according to the values listed in the PFR Evaluation Table. The PFR Report will contribute to the total score of the competition according to the score value specified in the Contest Score Template document.

Score Weight: 8%

3.8 Deliverable Submission and Scheduling

The first 4 documents listed in the table below will be sent to the e-mail address modeluydu@turksat.com.tr by considering the document format and due date by the team advisor. All documents except Flight Telemetry Data and Ground Station Video documents will be in .pdf format. Documents sent in any format other than .pdf will not be accepted.

At the end of the competition, the most nicely arranged POR, PDR, CDR and PFR can be given on the website for reference to the participants in the following years.

Document	Required Format Format	Due Date
POR	TMUY2018_xxxx_POR_vYY.pdf	**March 17, 2019 - 23:59**
PDR	TMUY2018_xxxx_PDR_vYY.pdf	**April 28, 2019 - 23:59**
CDR	TMUY2018_xxxx_CDR_vYY.pdf	**July 7 2019 - 23:59**
QR	TMUY2018_xxxx_QR_vYY.pdf	**September 8, 2019 - 23:59**
OMC	TMUY2018_xxxx_OPY_vYY.pdf	After FRR
Flight Telemetry Data and Ground Station Video	TMUY2018_xxxx_TLM.csv TMUY2018_xxxx_VIDEO	During the competition
PFR	TMUY2018_xxxx_PFR_vYY.pdf	10:00 – 1 day later from competition

3.9 Presentation Guide

Presentation Guide will be published before the PDR and CDR processes.

4. FLIGHT OPERATIONS

4.1 Program

The detailed program will be informed to the teams that are in progress after the CDR phase.

4.2 Flight Readiness Review (FRR)

It is the phase which the teams are checked for flight worthiness. Successful completion of this phase means that the Model Satellite is ready for flight. **FRR consists of 5 stages**;

In the first phase of the FRR, the communication test will be carried out. To pass this test; the telemetry data shall be transmitted to the ground station computer and plotted in real time on the ground station.

The second phase in the FRR is the fall test. The container will be connected with 1 meter of rope and the Model Satellite (Container + Science Payload) will be carried out by releasing it from a height of 1.5 meters. It is desirable that the science payload does not break from the container and the system remains undamaged. In order to pass this test, the data will continue to be transmitted while the ground station is in progress. At the end of the test, the Model Satellite shall not be damaged and the data transmission must continue. If the test fails, the team must perform repairs before proceeding to FRR.

The third phase in FRR; is the stage at which separation will be observed. The satellite passing the second phase will send separation comment to the ground station. With the release command, the release mechanism between the container and the science payload will be executed and the separation will be performed.

The fourth phase in the FRR is the security check phase. Installation of electronic equipment and sensors will be examined. Mechanisms will be reviewed.

The final phase in FRR is the examination of the size and weight. If the measured values are at the values specified in the competition requirements, the test phase will be completed.

Teams that cannot pass the FRR will be given time until 10:30 on the day of the competition. However, the effect of the flight score will be evaluated over 40% instead of 50%. (See Competition Scoreboard)

The teams shall come to FRR with 2 hardcopies from the Operation Management Check Chart. One of the copies will be given to the competition staffs and other will be reviewed together.

4.3 Team Member Flight Operations Crew Assignments

Crew assignments must be submitted at the Operation Management Check Chart in detail.

”Operation Management Control Chart“ will be reviewed in the flight readiness review.

Team members must be assigned roles during the flight operation. For a successful operation, the teams must be coordinated with each other and with the competition coordinators.

Team members must be assigned to specific tasks and develop a checklist for a successful flight. Members in the team must be assigned for the following tasks:

Mission Control Officer: This is a single person who is responsible for informing the Flight Coordinator when the team and their Model Satellite is ready to be flighted and managing whole operation.

Ground Station Crew: This is one or more persons who is responsible for monitoring the ground station for telemetry reception and issuing commands(e.g. release command) to the Model Satellite. This team will deliver the “Flight Telemetry Data” and “Ground Station Video” to the Ground Station Coordinator.

Preparation Crew: This is one or more persons responsible for preparing the Model Satellite, integrating it into the rocket, and verifying its status.

Recovery Crew: This is one or more persons responsible for tracking the CanSat and going out into the field for recovery and interacting with the field judges. This crew is responsible for making sure all field scores are filled in or loss of points will occur.

Team members can take on multiple roles except for the Mission Control Officer. The Mission Control Officer should be coordinating all efforts and interacting with the flight coordinator as needed. **It will develop a checklist that guides teams during preparation, integration and flight operations. (**It can be based on the sequence of events.**).** This checklist will be added to the Operations Management Control Chart document.

4.4 Flight Schedule

Teams that cannot pass the FRR will be given time until the competition time. However, the effect of the flight score will be evaluated over 40% instead of 50%. The teams who qualify for the competition will deliver the Model Satellites to Operation Judge. The Model Satellite must be delivered after you have configured the science payload to 0 meters in height.

4.5 Competition Operations and Sequence of Events

Details of flight day operations shall be provided at the Pre-Flight Brief. An overview of the flight day operations include the following activities:

1. Arrive at flight site.
2. Installation of the ground station in the assigned tables.
3. The height is set to 0 meters from ground station.
4. Preparing the Model Satellite for flight and final testing.
5. Delivery of the Model Satellite to the Operation Judge fully assembled and the electronic circuit closed in the control panel. (The model Satellite shall be kept closed until the flight time of the relevant team.)
6. Mission Control Officer and Preparation Crew will go to the control desk. Then they will place the Model Satellites on the flight platform with the Operation Judge.
7. The Mission Control Officer and the Flight Coordinator shall implement the initiation procedures.
8. Ground Station Crew; The model will verify that the ground station communicates with the Satellite.
9. As for the flight time, the Ground Station Judge and the Ground Station Crew follow the ground station operation.
10. Ground Station Crew delivery of flight information to the Ground Station Judge.
11. The Ground Station Crew will carry out all necessary flight operations.
12. At the time of landing and after, the Rescue Crew shall follow the science payload and container and go to the landing site. The teams shall determine the location of the science payload using the GPS data received from the Ground Station Crew.
13. The Rescue Crew members who find the container and the science payload should call the Field Crew. Do not interfere with the Model Satellite until the Field Judge arrives.
14. The Field Judge and the Rescue Crew members will review the science payload.
15. Back to the competition area.

4.6 Disqualification Guidelines

- The teams that copy content or design from other teams,
- The teams that deliver documents that is blank or have meaningless content,
- The teams that do not comply with safety precautions in Flight Day,
- The teams that sabotage the operation and flight process of other teams,
- The teams that act verbally or in writing (including social media) who act in a manner that disrupts the peace of the competition or competition officials before, during and after the competition will be disqualified.

4.7 Weather Conditions

In order to control the physical workability of Model Satellite Designs, it is aimed to make Flight Rating which is the most important stage of the competition process. During a normal flight, the Flight Operation Scoring Table basically asks for the landing speed, release of the model satellite, the transfer of telemetry data and flight images to the ground station during flight, and visualization of these data on the ground station computer. In case the flight is not realized, scoring is performed on the basis of most of the normal flight requirements specified in the Flight Operation Scoring Table. FLIGHT_PLAN_B is applied for the following weather conditions. FLIGHT_PLAN_B is published before the flight.

Conditions that may prevent the flight are as follows:

- Wind speed and rainy weather that will pose a risk to your drone flight or hinder your flight:

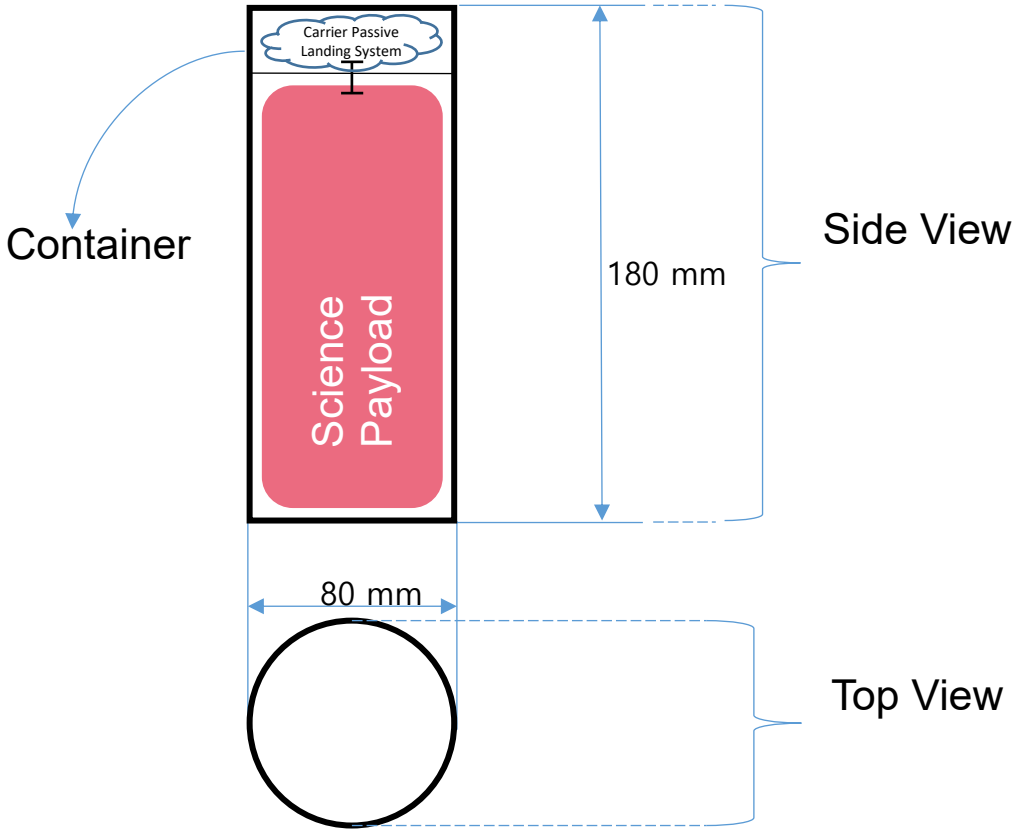
STABIL FLIGHT	SEMI STABILITY FLIGHT	RISKY FLIGHT	FLIGHT CANCELLATION
0-15 KNOT	15-24 KNOT	24-32 KNOT	32-MORE KNOT

- Force majeure caused by the flight team or security reasons that may occur in the organization area.

5. APPENDIX

5.1 Model Satellite Mechanical Design Description

In accordance with #3 of the technical requirements; The draft structure of the Container and Science Payload sections of the Model Satellite that will be designed are listed below.



5.2 Axis Position Information

In accordance with #34 of the technical requirements; the example of axis position information and 2 dimensional simulation image is as follows: