Design Reports Webinar

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ARTEMIS STUDENT CHALLENGES
nasa.gov/stem/artemis.html

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Webinar Overview

- Milestone Overview
- Design Reports Schedule
- Proposal Expectations
- Preliminary Design Expectations
- Critical Design Expectations
- Flight Readiness Expectations
- Post Launch Assessment Expectations
- Flysheets
- Project Management

Mark

Meet the FNL Team

Wisconsin Space Grant Foundation

- Kevin Crosby, Director — kcrosby@carthage.edu
- Christine Bolz, Assistant Director — cbolz@carthage.edu
- Rob Cannon, FNL Project Manager — rcannon@carthage.edu
- Connie Engberg, Project Support Assistant — cengberg@carthage.edu
- Megan Goller, Accounts Assistant — mgoller@carthage.edu

First Nations Launch

- Frank Nobile, Technical Coordinator, Wisconsin Tripoli — maxq3@aol.com
- Mark Abotossaway, Project Assistant/Advisor Liaison, Blue Origin (Alumni) — mark.a.abotossaway@gmail.com

Tripoli Rocket Association

- Bob Justus, Tripoli Assistant, Illinois Tripoli — bob@mhbofni.com
- Kevin Harnack, Tripoli Assistant, Wisconsin Tripoli

Design Milestones Overview

- Initial Milestone
  - Industry – Request for Proposals (RFP)
  - Academia – Notice of Intent (NOI)
- Phase Gated Process
  - Proposal
  - Preliminary Design
  - Critical Design
  - Flight Readiness
  - Post Launch Assessment
- Each Phase is ‘Gated’
  - Must be successfully passed to move through gate

Design Milestones Overview

- Each Milestone Involves:
  - Design Freeze
  - Written Design Report
  - Flysheet
  - Virtual Review *

- Each Design Report Includes:
  - Team Overview
  - Facilities / Equipment*
  - Vehicle Design
  - Challenge Design
  - Safety
  - Project Management

Reports Schedule

Notice of Intent	Oct 20, 2023
Proposal Report	Dec 11, 2023
Preliminary Design – Report	Jan 22, 2024
Preliminary Design – Virtual	Jan 29 – Feb 2, 2024
Critical Design – Report	Feb 26, 2024
Critical Design – Virtual	Mar 4 - 8, 2024
Flight Readiness – Report	Apr 1, 2024
Flight Readiness – Virtual (Inspection)	Apr 8 - 11, 2024
Launch Weekend Presentation	Apr 26, 2024
Post Launch Assessment	May 13, 2024

Key: Written Report Oral Report

Proposal Phase

- Proposal Phase includes:
  - Forming stage of Team Development
  - Outlining / acquiring the resources needed
    - Advisor and Mentor and Team Members
  - Understanding Rocketry and Payload Safety
  - Initial Technical Design Concepts
    - Rocketry and Challenge
    - Trade Studies and Simulations
  - Drafting Project Management
    - Test Plan and Requirements
    - Budget and Schedule
      - No procurement at this phase

Proposal Phase

- Proposals should show trade studies of various design ideas
  - Examine various rocket materials / sizes / costs
    - Ensure you are meeting vehicle requirements
  - Examine various payload / challenge options
    - Ensure you are meeting challenge requirements
  - Include RockSim simulations
    - Ensure you are meeting performance requirements
  - Draft initial Project Management documents
    - Test Plan, Requirements, Budgets, Schedules
  - No procurement at Proposal Phase (trade studies)

Reports Overview

	Proposal	PDR	CDR	FRR	PLAR
Team Summary	X				
Facilities and Equipment	X				
Vehicle Criteria					
Challenge Criteria					
Safety	X				
Design Overview	X				
Project Plan – Test	X				
Project Plan - Requirements	X				
Project Plan - Budget	X				
Project Plan - Schedule	X				

Preliminary Design (PDR) Phase

- PDR Phase Includes:
  - Storming phase of Team Development
  - Technical Design Rocket Vehicle
    - Down selection of technical concepts in Proposal
    - Refine component selections
    - Update Simulations
  - Challenge Details
    - Refinement and component selection
  - Safety
  - Project Management
    - Update Test Plan and Requirements
    - Update Budget and Schedule

Preliminary Design (PDR) Phase

- Preliminary Design should begin to narrow design options
  - Focus should be on Payload / Challenge
    - It is easier to adjust the rocket selection to the Payload
  - You may still be uncertain about other components / ideas
    - These options should still be presented
  - Mockups (procurement) should begin after Proposal
    - These may help make / eliminate a design choice
  - Rocketry components (avionics) may also be procured
    - Altimeters and GPS tracking
  - Wait to procure rocket / recovery components until Payload design is near complete
  - Component testing should continue here

Reports Overview

	Proposal	PDR	CDR	FRR	PLAR
Team Summary	X	X			
Facilities and Equipment	X				
Vehicle Criteria		X			
Challenge Criteria		X			
Safety	X	X			
Design Overview	X				
Project Plan – Test	X	X			
Project Plan - Requirements	X	X			
Project Plan - Budget	X	X			
Project Plan - Schedule	X	X			

Critical Design (CDR) Phase

- CDR Phase Includes:
  - Forming phase of Team Development
  - Technical Design Rocket Vehicle
    - Final rocket component selections
    - Update simulations
    - Motor selection
  - Challenge Details
    - Final Payload component selections
  - Safety
  - Project Management
    - Update Test Plan and Requirements
    - Update Budget and Schedule

Critical Design (CDR) Phase

- Critical Design should show all design choices are complete
  - The Launch Weekend motor selection is due here
    - There should be little mass changes after this date
  - All component (vehicle / payload) procurements should be wrapping up
    - All components should be accounted for
      - In the Budget
      - In the mass balance
      - In the RockSim simulation
  - Assembly testing should continue here

Reports Overview

	Proposal	PDR	CDR	FRR	PLAR
Team Summary	X	X	X		
Facilities and Equipment	X				
Vehicle Criteria		X	X		
Challenge Criteria		X	X		
Safety	X	X	X		
Design Overview	X				
Project Plan – Test	X	X	X		
Project Plan - Requirements	X	X	X		
Project Plan - Budget	X	X	X		
Project Plan - Schedule	X	x	x		

Flight Readiness (FRR) Phase

- FRR Phase includes:
  - Performing phase of Team Development
  - Technical Design Vehicle
    - Design / Build / Fabrication complete
  - Challenge Details
    - Design / Build / Fabrication complete
  - Safety
  - Project Management
    - Tests should be complete, requirements met
    - Budget and Schedule should be finalized

Flight Readiness (FRR) Phase

- Flight Readiness should show the vehicle / payload are ready for flight
  - The as-built vehicle / payload should match latest design
  - Simulations should match as-built
  - Any discrepancies should be accounted for

  - All procurement should be complete
  - All testing should be complete

Reports Overview

	Proposal	PDR	CDR	FRR	PLAR
Team Summary	X	X	X	X	
Facilities and Equipment	X				
Vehicle Criteria		X	X	X	
Challenge Criteria		X	X	X	
Safety	X	X	X	X	
Design Overview	X				
Project Plan – Test	X	X	X	X	
Project Plan - Requirements	X	X	X	X	
Project Plan - Budget	X	X	X	X	
Project Plan - Schedule	X	X	X	X	

Post Launch Assessment (PLAR) Phase

- PLAR Phase includes:
  - Vehicle Performance Analysis
    - Assess if Vehicle performed as expected
    - Explain any anomalies
  - Challenge Performance Analysis
    - Assess if Challenge performed as expected
    - Explain any anomalies
  - Project Review
    - Provide a Project Review

Reports Overview

	Proposal	PDR	CDR	FRR	PLAR
Team Summary	X	X	X	X	X
Facilities and Equipment	X				
Vehicle Criteria		X	X	X	X
Challenge Criteria		X	X	X	X
Safety	X	X	X	X	
Design Overview	X				
Project Plan – Test	X	X	X	X	
Project Plan - Requirements	X	X	X	X	
Project Plan - Budget	X	X	X	X	
Project Plan - Schedule	X	X	X	X	

Report and Virtual Templates

- Use the Templates
  - On the website
  - Link posted in chat
    - https://spacegrant.carthage.edu/first-nations-launch/rubric/
- Review template at phase start
  - Know what you are working to
  - No surprises
  - Template shows level of detail needed

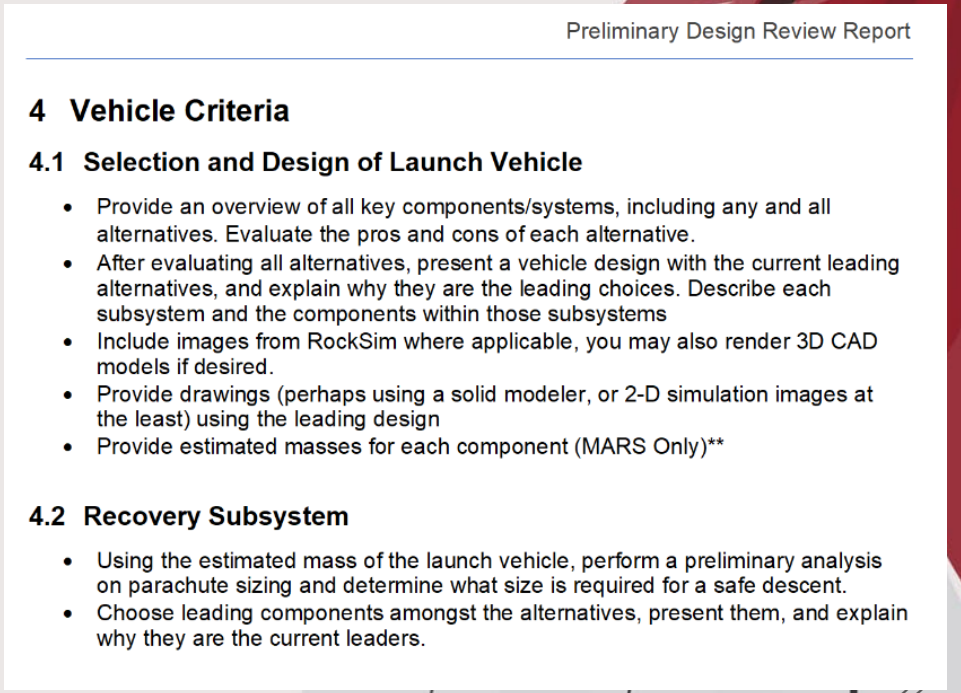
Scoring Rubric

The Moon/Mars Rocket Competitions will be judged by these separate parts:

1. **Design Reports** (75% of total score)
Flysheet At every cycle (Proposal, PDR, etc) every team (every challenge) will fill out a Flysheet and submit a PDF of the Flysheet along with the PDF report.
   a. Competition Proposal (5%)
      i. Flysheet (Proposal Tab)
   b. Preliminary Design Review (PDR) (15%)
      i. PDR Virtual Review w/judges (5%)
      ii. Flysheet (PDR Tab)
   c. Critical Design Review (CDR) (15%)
      i. CDR Virtual Review w/judges (5%)
      ii. Flysheet (CDR Tab)
   d. Flight Readiness Review (FRR) (15%)
      i. Flysheet (FRR Tab)
      ii. Safety Inspection Checklist - Virtual Review (5%)
   e. Post Launch Assessment Review (PLAR) (10%)

Written Report Template

- Plug and Chug
  - Address the bullet points
  - Reformat accordingly
  - Remove the bullet text
- Proposal is probably the most work
  - Each Report builds on previous
    - Updating tables etc
- Use MS Word functionality
  - Headers / sub-headers
  - Captions / references



Preliminary Design Review Report

4 Vehicle Criteria

4.1 Selection and Design of Launch Vehicle

- Provide an overview of all key components/systems, including any and all alternatives. Evaluate the pros and cons of each alternative.
- After evaluating all alternatives, present a vehicle design with the current leading alternatives, and explain why they are the leading choices. Describe each subsystem and the components within those subsystems
- Include images from RockSim where applicable, you may also render 3D CAD models if desired.
- Provide drawings (perhaps using a solid modeler, or 2-D simulation images at the least) using the leading design
- Provide estimated masses for each component (MARS Only)**

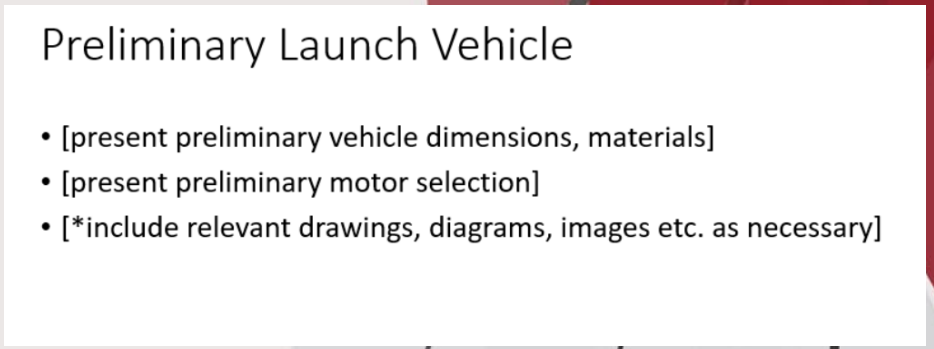
4.2 Recovery Subsystem

- Using the estimated mass of the launch vehicle, perform a preliminary analysis on parachute sizing and determine what size is required for a safe descent.
- Choose leading components amongst the alternatives, present them, and explain why they are the current leaders.

Virtual Report Template

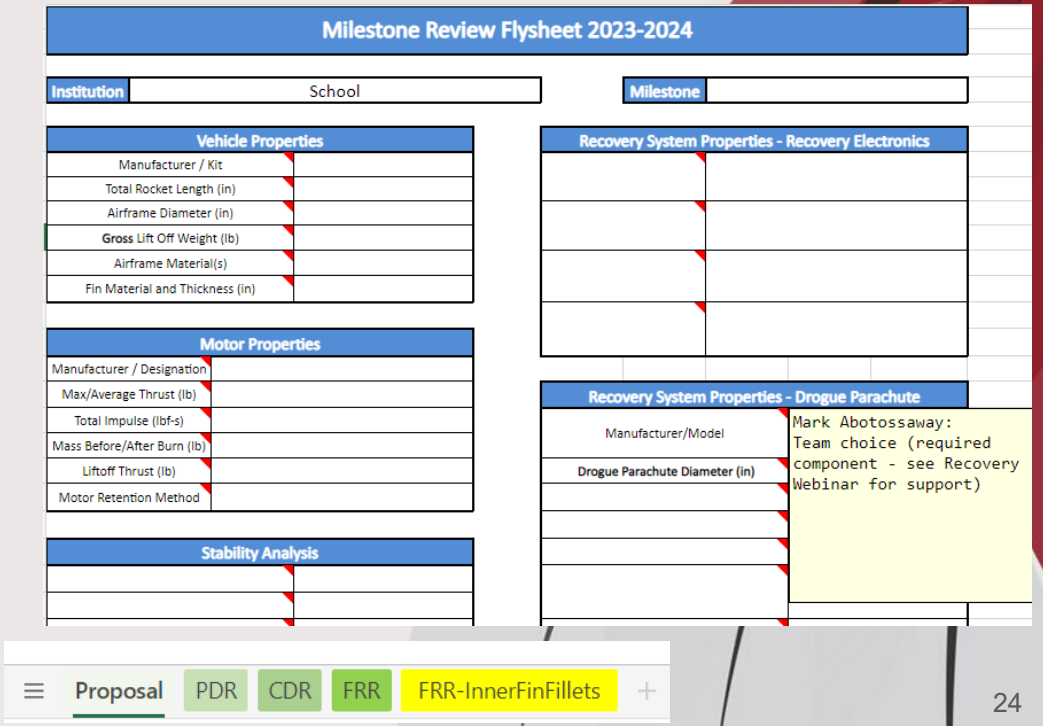
- Plug and Chug
  - Pull data from Written Report
  - Ensure Virtual Presentation aligns with Written Report

- Practice your Presentation
  - For timing – not much time allocated
  - Use images! (over text)



Flysheets Template

- Plug and Chug
  - Ensure the data aligns between Written Report and Flysheet
  - Ensure you are using the correct sheet (tab) for the Milestone
  - Only fill out the required data for that Milestone



Milestone Review Flysheet 2023-2024

Institution	School	Milestone	

Vehicle Properties	
Manufacturer / Kit	
Total Rocket Length (in)	
Airframe Diameter (in)	
Gross Lift Off Weight (lb)	
Airframe Material(s)	
Fin Material and Thickness (in)	

Recovery System Properties - Recovery Electronics	

Motor Properties	
Manufacturer / Designation	
Max/Average Thrust (lb)	
Total Impulse (lbf-s)	
Mass Before/After Burn (lb)	
Liftoff Thrust (lb)	
Motor Retention Method	

Recovery System Properties - Drogue Parachute	
Manufacturer/Model	Mark Abotossaway: Team choice (required component - see Recovery Webinar for support)
Drogue Parachute Diameter (in)	

Stability Analysis	

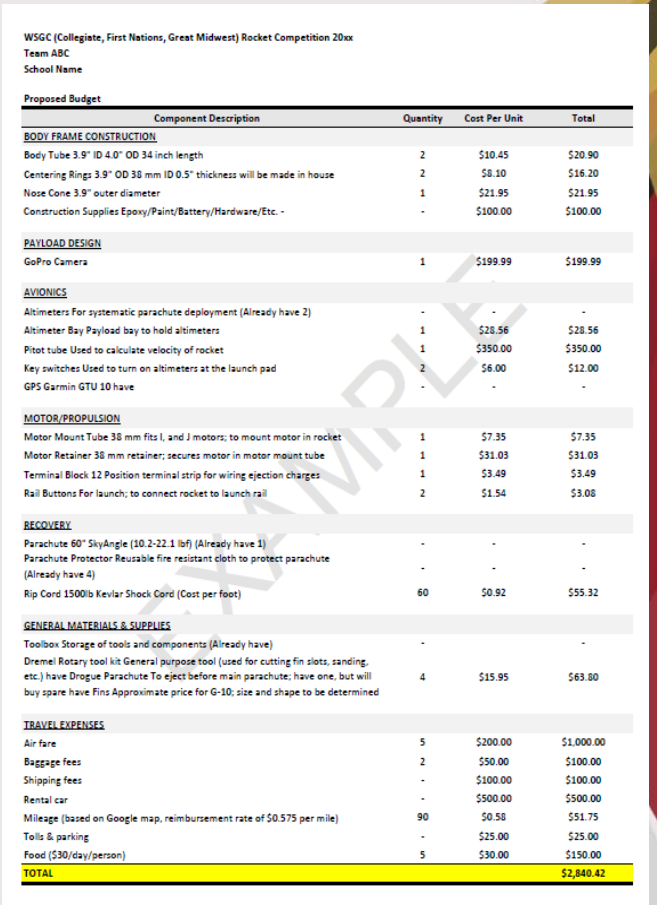
Proposal | PDR | CDR | FRR | FRR-InnerFinFillets

Flysheets Overview

- Transmit rocketry (simulation) performance data
  - This data tells us:
    - that your simulations are accurate
    - that your component selections are accurate
- Some of the flysheet (rocketry) data have required values
  - This data tells us you understand / meet the requirements
- Flysheet required at each milestone
  - The required data is progressive
    - Proposal only requires a few fields filled
    - FRR requires all fields filled

Budgets

- Budget requirements are to help you manage your budget
  - Team Lead should create and maintain a spreadsheet
  - Include a snapshot of the spreadsheet at each Milestone
- For example;
  - At Proposal, budget can simply be split into sections
    - Challenge - $1500, Vehicle - $1500, Travel - $2000
  - Further refine spreadsheet at each progressive Milestone
  - Include headers in your Budget such as:
    - Subsection / Component / Manufacturer / Vendor / Cost / Shipping
- The Budget here is from your reports
  - There is another Budget required by WSGC Admin (this is Advisor provided)
- Budget guidance as Appendix C in Competition Handbook



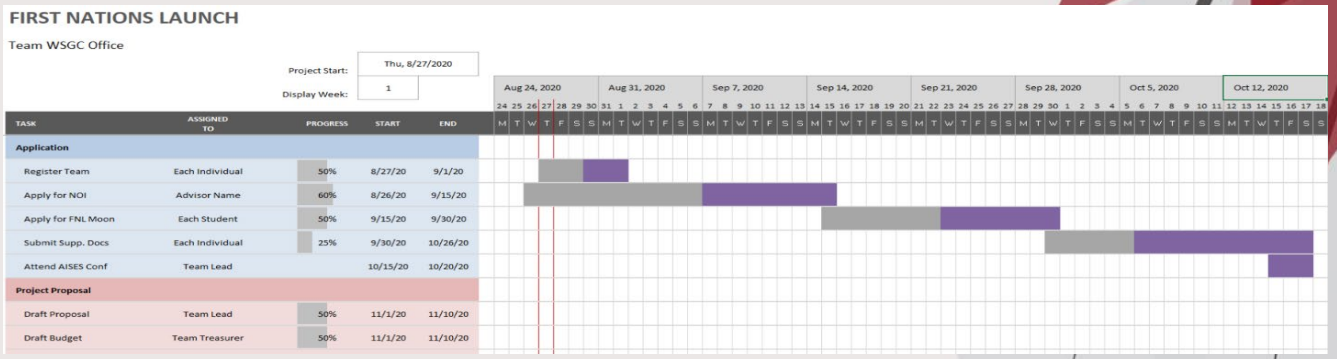
WSGC (Collegiate, First Nations, Great Midwest) Rocket Competition 20xx
Team ABC
School Name

Proposed Budget

Component Description	Quantity	Cost Per Unit	Total
BODY FRAME CONSTRUCTION			
Body Tube 3.9" ID 4.0" OD 34 inch length	2	$10.45	$20.90
Centering Rings 3.9" OD 38 mm ID 0.5" thickness will be made in house	2	$8.10	$16.20
Nose Cone 3.9" outer diameter	1	$21.95	$21.95
Construction Supplies Epoxy/Paint/Battery/Hardware/Etc. -	-	$100.00	$100.00
PAYLOAD DESIGN			
GoPro Camera	1	$199.99	$199.99
AVIONICS			
Altimeters For systematic parachute deployment (Already have 2)	-	-	-
Altimeter Bay Payload bay to hold altimeters	1	$28.56	$28.56
Pitot tube Used to calculate velocity of rocket	1	$350.00	$350.00
Key switches Used to turn on altimeters at the launch pad	2	$6.00	$12.00
GPS Garmin GTU 10 have	-	-	-
MOTOR/PROPULSION			
Motor Mount Tube 38 mm fits I, and J motors; to mount motor in rocket	1	$7.35	$7.35
Motor Retainer 38 mm retainer; secures motor in motor mount tube	1	$31.03	$31.03
Terminal Block 12 Position terminal strip for wiring ejection charges	1	$3.49	$3.49
Rail Buttons For launch; to connect rocket to launch rail	2	$1.54	$3.08
RECOVERY			
Parachute 60" SkyAngle (10.2-22.1 lbf) (Already have 1)	-	-	-
Parachute Protector Reusable fire resistant cloth to protect parachute (Already have 4)	-	-	-
Rip Cord 1500lb Kevlar Shock Cord (Cost per foot)	60	$0.92	$55.32
GENERAL MATERIALS & SUPPLIES			
Toolbox Storage of tools and components (Already have)	-		-
Dremel Rotary tool kit General purpose tool (used for cutting fin slots, sanding, etc.) have Drogue Parachute To eject before main parachute; have one, but will buy spare have Fins Approximate price for G-10; size and shape to be determined	4	$15.95	$63.80
TRAVEL EXPENSES			
Air fare	5	$200.00	$1,000.00
Baggage fees	2	$50.00	$100.00
Shipping fees	-	$100.00	$100.00
Rental car	-	$500.00	$500.00
Mileage (based on Google map, reimbursement rate of $0.575 per mile)	90	$0.58	$51.75
Tolls & parking	-	$25.00	$25.00
Food ($30/day/person)	5	$30.00	$150.00
TOTAL			$2,840.42

Schedules

- Schedule requirements are to help you manage your schedule
  - Team Lead should create and maintain a Gantt Chart
  - Include a snapshot of the Gantt Chart at each Milestone
- Gantt Chart should include timelines of;
  - Report Deadlines and Virtual Reviews
  - Simulations, Trade Studies Window
  - Testing Plan Window
  - Procurement Window
  - Build and Fabrication Window
- Teams typically end up struggling with (accelerating) their schedules
  - Do not ignore the importance of good schedule planning
- Scheduling guidance as Appendix C in Competition Handbook



FIRST NATIONS LAUNCH

Team WSGC Office

Project Start: Thu, 8/27/2020

Display Week: 1

Aug 24, 2020 | Aug 31, 2020 | Sep 7, 2020 | Sep 14, 2020 | Sep 21, 2020 | Sep 28, 2020 | Oct 5, 2020 | Oct 12, 2020

TASK	ASSIGNED TO	PROGRESS	START	END
Application				
Register Team	Each Individual	50%	8/27/20	9/1/20
Apply for NOI	Advisor Name	60%	8/26/20	9/15/20
Apply for FNL Moon	Each Student	50%	9/15/20	9/30/20
Submit Supp. Docs	Each Individual	25%	9/30/20	10/26/20
Attend AISES Conf	Team Lead		10/15/20	10/20/20
Project Proposal				
Draft Proposal	Team Lead	50%	11/1/20	11/10/20
Draft Budget	Team Treasurer	50%	11/1/20	11/10/20

Test Plans

- Test Plans are to ensure your components function individually
  - Team Lead should create a Test Plan spreadsheet
  - Include a snapshot of the Test Plan at each Milestone
- Test Plans should be created for all components / assemblie
  - It is up to the team to determine
    - What components to test (during design)
    - When to test (schedule)
    - What constitutes a successful test
    - Include test status in your reports
- Tests may culminate in a full-scale test flight (not required)
- Test guidance as Appendix C in Competition Handbook

Requirements Verification

- Requirements Verification ensure you are designing properly
  - Team Lead should create a Requirements Verification spreadsheet
  - Include a snapshot of spreadsheet at each Milestone
- Requirements are provided in Competition Handbook
  - Ensure you are addressing / satisfying all requirements
  - Create a list of requirements
    - Determine how you will satisfy the requirement
    - Determine who is responsible for the requirement
    - List the status of the requirement verification
  - Missing a requirement will lead to large design changes / schedule issues
- Requirements guidance is an Appendix C in Competition Handbook

Report Tips and Tricks

- Veteran Teams
  - Do not simply reuse your old reports – Templates change each year
- Ensure units are consistent in reports / simulations
  - Agree on a set of units at the start of the program
- A picture is worth a thousand words
  - Use pictures more often than text descriptions
  - Include pictures of all component selections

Report Tips and Tricks

- Learn (Acquire) RockSim as soon as possible
  - Include RockSim data / images in your Report and Flysheets
- Use the MS Word functionality
  - Create section sub-headers (templates already have basic headers)
  - Use Figure / Table captions and References
- Use Appendix for large tables or data

Questions?