Design Reports Webinar

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Blue Origin Engineer and FNL Assistant

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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
Meet the FNL Team

**Wisconsin Space Grant Foundation**
- Kevin Crosby, Director
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- Christine Bolz, Assistant Director
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- Rob Cannon, FNL Project Manager
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- Megan Goller, Accounts Assistant
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**First Nations Launch**
- Frank Nobile, Technical Coordinator, Wisconsin Tripoli
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- Mark Abotossaway, Project Assistant/Advisor Liaison, Blue Origin (Alumni)
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**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

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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
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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
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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
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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
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Report and Virtual Templates

- **Use the Templates**
  - On the website
  - Link posted in chat
    - [https://spacegrant.carthage.edu/first-nations-launch/rubric/](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

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**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

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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)

Preliminary Launch Vehicle

- [present preliminary vehicle dimensions, materials]
- [present preliminary motor selection]
- [*include relevant drawings, diagrams, images etc. as necessary]
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
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
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
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 / assembly
  ○ 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?