L'SPACE Academy 1 Preliminary Design Review (PDR) – Characterizing the Water Feed Stock for Human Landing Sites

Descent, Lander, and Payload Experiment Criteria

The PDR demonstrates that the overall program preliminary design meets all requirements with acceptable risk, within cost, within schedule constraints, and establishes the basis for proceeding with detailed design. It shows that the correct design options have been selected, interfaces have been identified, and verification methods have been described. Full baseline cost and schedules, as well as all risk assessment, management systems, and metrics are presented. (NPR 7120.5D p.30)

The panel will be expecting a professional and polished report. Please use Arial, size 12 font for your PDR Report. Your PDR must include page numbers, figure and table labels and descriptions, and image credits. Please check for grammatical errors, spelling errors, and proper capitalization.

Important Note:

- *For review purposes,* ***your PDR document must follow the order of sections as they appear below.***
- *Give as detailed descriptions and data as possible to give the reviewers the information they need to approve your plan.*

It is important to remember that it is the defined **science objectives** of your mission that will determine your team's **engineering design**.

Preliminary Design Review Report

I) Summary of PDR Report

1.1 Team Summary

1.1.1 College and university names;
1.1.2 Locations; and
1.1.3 List of relevant expertise on team.

1.2 Descent Summary

1.2.1 Description of entry, descent, and landing sequence.

1.3 Lander and Payload Summary

1.3.1 Description of each mission element (probe and science payload) – please include mass and size dimensions for each element and how it maps to the overall mission mass, size, and performance constraints;
1.3.2 Description of surface experiment deployment system; and
1.3.3 Summarize experiment(s) and how the science obtained will map to the overall mission objectives.

II) Evolution of Project

2.0 Highlight All Changes Made Since the Initial Concept Was Identified and the Reason for those Changes

2.1.1 Changes made to Descent and Lander Criteria;
2.2.1 Changes made to Payload Criteria; and
2.3.1 Changes made to Mission Experiment Implementation Plan.

III) Science Value

3.0 Highlight the Science Payload and Value to Mission Objectives

3.1.1 Describe Science Payload Objectives
3.1.2 State the payload success criteria;
3.1.3 Describe the experimental logic, describe landing site using JMARS (including JMARS image), and method of your investigation;
3.1.4 Describe test and measurement, variables and controls;
3.1.5 Show relevance of expected data, accuracy/error analysis;
3.1.6 Describe the Preliminary Experiment process procedures; and
3.1.7 Describe the steps and procedures the project is taking to integrate communication and planning tasks with the engineering team to optimize the science return.

IV) Descent and Lander Criteria

4.1. Selection, Design, and Verification of Descent and Lander Mechanism

4.1.1 Mission Statement, Requirements, and Mission Success Criteria
4.1.2 Major Milestone Schedule (A. Project Initiation, B. Design, C Manufacturing, D. Verification, E. Operations, and F. Major Reviews –

Systems Review Readiness (SRR), Preliminary Design Review (PDR), Critical Design Review (CDR), Test Readiness Review (TRR) – including estimated dates of occurrence – include these on your schedule as well);

4.1.3 Review the design at a system level, going through each system's functional requirements (Includes sketches or CAD of options, selection rationale, selected concept and characteristics) – all drawings or CAD should include a front, side, and top point of view and dimensions of each;

4.1.4 Describe any subsystems that are required to accomplish the overall mission;

4.1.5 Describe the performance characteristics for the system and subsystem (if applicable) and determine the evaluation and verification metrics;

4.1.6 Describe the verification plan and its status;

4.1.7 Define the risks and the plans for reducing the risks through analysis or testing for each system. A risk plot that clearly portrays the risk mitigation schedule is highly encouraged. Take all factors that might affect the project including risks associated with testing – e.g., acquisition, power source, delivery of parts, changing of design or payload, adequate personnel, holiday schedules, budget costs, etc.;

4.1.8 Demonstrate an understanding of all components needed to complete the project and how risks/delays impact the project;

4.1.9 Demonstrate planning of manufacturing, verification, integration, and operations. (Include component testing, functional testing, or static testing);

4.1.10 Confidence and maturity of design; and

4.1.11 Include a dimensional CAD drawing of entire assembly.

4.2 Mission Performance Predictions *(Highlighted Because of Criticality)*

4.2.1 State mission performance criteria (starting with release of the probe through landing and experiment deployment);

4.2.3 Show flight profile simulations, altitude predictions with simulated descent and lander data, component weights, and different descent profiles depending on Mars local weather conditions at the team's choice of a landing site; and

4.2.4 Show Stability margin, simulated CP: Center of Pressure/ CG: Center of Gravity relationship and locations.

4.3 Payload Integration

4.3.1 Describe integration plan with the Mars Orbiter and the probe payload.

4.4 Earth Testing Operation Procedures

4.4.1 Determine what type of testing system will be used for the Earth analog testing of a component of your science experiment; and
4.4.2 Develop an outline of final assembly for the Earth testing.

4.5 Safety and Environment for Protocols for Earth-based Testing of a Component from Your Science Experiment

4.5.1 Identify Safety Officer for your team (must be present in-person at Earth testing site or Team Safety Officer need to designate an on-site person.)
4.5.2 Provide a Preliminary analysis of the failure modes of the proposed design of the descent and lander vehicles, payload integration and deployment operations, including proposed and completed mitigations;
4.5.3 Provide a listing of personnel hazards: The Safety Officer and the team are responsible for surrounding environment including pedestrians and colleagues during the drop tests. Include data demonstrating that safety hazards have been researched (such as Material Safety Data Sheets, operator's manuals, NAR regulations), and that hazard Mitigations have been addressed and mitigate; and
4.5.4 Discuss any environmental concerns – Explain optimal testing environment conditions (e.g., weather conditions, landing surface, etc.).

V) Payload Criteria

5.1 Selection, Design, and Verification of Payload Experiment

5.1.1 Review the design at a system level, going through each system's functional requirements (includes sketches of options, selection rationale, selected concept and characteristics);
5.1.2 Describe the payload subsystems (if applicable) that are required to accomplish the payload objectives;
5.1.3 Describe the performance characteristics for the system (and subsystems if applicable) and determine the evaluation and verification metrics;
5.1.4 Describe the verification plan and its status;
5.1.5 Describe preliminary integration plan; and
5.1.6 Determine the precision of instrumentation and repeatability of the measurements.

5.2 Payload Concept Features and Definition

5.2.1 Creativity and originality;
5.2.2 Uniqueness or significance; and
5.2.3 Suitable level of challenge.

VI) Activity Plan

6.1 Show Status of Activities and Schedule

6.1.1 Budget Plan- Cost all items (even free items should be listed with estimated cost if purchased)
6.1.2 Schedule – L'SPACE Academy 1: This schedule will include all activities from beginning of project to PDR. L'SPACE Academy 2: This schedule will include all activities after the PDR, including the Earth testing.
6.1.3 Mission Education and Public Outreach Summary

VII) Conclusion

7.0 Summary of Mission

7.1.1 Progress on mission formulation and design up to CDR
7.1.2 Testing Results and mission success outlook (Academy 2)

Modified from NASA's Student Launch Initiative PDR Document - https://www.nasa.gov/pdf/206051main_Preliminary_Design_Review_Req_508.pdf