Revision	List of Changes	Date
0	N/A	10 – 1 – 2020

1 - Purpose

This schedule marks major milestones for both Project Messenger and Project Aries. Unless otherwise noted, Reports and Design Reviews are given BY the responsible design group(s), TO a panel established by the Technical Planning Committee. Such a panel can include professors, alumni, and outside experts and is intended to convince the HLA Review Panel that the design / operational requirements are being met in a safe, competent and economic fashion.

2 - Acronyms

YTD – Year To Date

ESRA – Experimental Sounding Rocket Association

SAC – Spaceport America Cup

NASA SL – Student Launch Competition

TBD – To Be Determined

COTS – Commercial Off the Shelf

SRAD – Student Researched and Designed

PEG – Propulsion Engineering Group

Consists of two Sections:

Systems Engineering

Chemical Engineering

T&LI – Test & Launch Infrastructure Group

Consists of two Sections:

ME 471 Senior Design Project *Test Stand for a Hybrid Rocket Engine Ground Firing*

ME 471 Senior Design Project *Propellant Transfer System for a Hybrid Rocket Engine*

ECE – I&C – Electrical & Computer Engineering Group

Instrumentation & Control Systems (I&C) Section

3 – Schedule (see Section 4 for color coding)

Date	Milestone	Coincides With
Thursday 10 – 1 – 2020	Official Start of Preliminary Design Work; Both Projects	End of September "Shakedown"
Thursday 12 – 3 – 2020	Messenger PDR	Last Full Week of Classes / ESRA 1st Progress Update (12/11)
Friday 12 – 4 – 2020	Aries PEG: Chemical Engineering PRR	Last Full Week of Classes
Saturday 12 – 5 – 2020	Aries PEG: Systems Engineering PDR	Last Full Week of Classes
Saturday 12 – 5 – 2020	Aries I&C PRR	Last Full Week of Classes
Monday 1 – 4 – 2021	Manufacturing, Testing, Fundraising; Both Projects	Start of Winter Break
Wednesday 3 – 3 – 2020	Messenger YTD Testing/Manufacturing Report (verbal from Project Lead to Chair of TPC)	ESRA 2nd Progress Update (3/5)
Thursday 3 – 25 – 2021	Messenger CDR	Start of Spring Break
Friday 3 – 26 – 2021	Aries PEG: Chemical Engineering PDR	Start of Spring Break
Saturday 3 – 27 – 2021	Aries PEG: Systems Engineering CDR	Start of Spring Break
Saturday 3 – 27 – 2021	Aries I&C PDR	Start of Spring Break
Friday 4 – 16 – 2020	Draft of ESRA Technical Report Deliverables	Week Before ESRA Rocket / Rocketeer Fee Payments (4/23)
Friday 5 – 14 – 2020	ESRA Technical Report Deliverables / ESRA 3rd Progress Update	----
Friday 6 – 11 – 2021	Messenger FRR	Week After Commencement
6 – 21 – 2021 to 6 – 25 – 2021	Messenger – 3 Mission	Spaceport America Cup

NOTE: Aries Test & Launch Infrastructure Group will follow the ME 471 Senior Design schedule.

4 - Deliverables

PRR – Preliminary Research Review

The PRR demonstrates an understanding of the problem scope, trade space of possible solutions, and how those possible solutions fit into the constraints of the project. No design work need be presented, and the presenters should avoid pre-biasing preliminary design work with "favorites" i.e. possible solutions that have yet to be thoroughly considered from an engineering perspective. The PRR is a review of what the problem is, how have others have solved it, and whether any of those prior solutions are disqualified due to constraints specific to the circumstances and requirements of this project.

PDR – Preliminary Design Review

The PDR demonstrates that the overall preliminary design meets all requirements with acceptable risk, within the cost, schedule, and technical performance constraints, and establishes the basis for proceeding with detailed design. It shows that the correct design options have been selected, and interfaces have been identified. Full baseline cost and schedules, as well as all risk assessment, management systems, and metrics, are presented. (NASA SL Handbook)

1.0 Summary of PDR Presentation
- a. Team Summary
  - i. Names & Roles within the team
  - ii. The team's location within the larger HLA organization

- b. Equipment Summary
  - i. Overview of all major specifications / compliance items that governed the design process
  - ii. Summary of leading design including mass budget, parts list, assembly drawing, major component suppliers and expected cost

2.0 Specification Changes Made Since October 1, 2020
- a. Highlight any changes to the Project Scoping or Technical Specification documentation and the reason for those changes

3.0 Design Criteria
- a. Identification, design and rational of all major subsystems
  - i. Review the design at a system level, going through each system's alternative designs, and evaluating the pros and cons of each alternative
  - ii. For each alternative, present research on why that alternative should or should not be chosen
  - iii. For each alternative, locate the essential points of difference on each design and show location(s) of energetic materials, if any

iv. After evaluating *all* alternatives, present the current *leading* alternatives, and explain why they are the leading choices
v. After evaluating the leading alternatives, present the current leading alternative and explain why it is the leading choice
    1. Describe each subsystem and the components within those subsystems
    2. Provide a dimensional drawing using the leading design
    3. Provide estimated masses for each subsystem
    4. Provide sufficient justification for design selections

4.0 Risk Analysis

a. Demonstrate an understanding of all components needed to complete the project, identifying "bottlenecks" and how risks/delays would impact the overall project schedule.

b. Provide a preliminary Personnel Hazard Analysis. The focus of the Hazard Analysis at PDR is identification of hazards, their causes, and the resulting effects. Preliminary mitigations and controls can be identified, but do not need to be implemented at this point unless they are specific to the construction and operations of the equipment. Rank the risk of each hazard for both likelihood and severity.
    i. Include data indicating that the hazards have been researched (especially personnel). Examples: NAR regulations, operator's manuals, MSDS, etc

c. Provide a preliminary Failure Modes and Effects Analysis (FMEA) for all major subsystems. Again, the focus for PDR is identification of hazards, causes, effects, and proposed mitigations. Rank the risk of each hazard for both likelihood and severity.

d. Discuss any environmental concerns using the same format as the Personnel Hazard Analysis and FMEA.
    i. This should include how the vehicle affects the environment and how the environment can affect the vehicle

e. Define the risks (time, resource, budget, scope/functionality, etc.) associated with the project. Assign a likelihood and impact value to each risk. Keep this part simple (i.e. low, medium, high likelihood, and low, medium, high impact). Develop mitigation techniques for each risk. Start with the risks with higher likelihood and impact, and work down from there. If possible, quantify the mitigation and impact. For example, including extra hardware to increase safety will have a quantifiable impact on budget. Including this information in a table is highly encouraged.

5.0 Project Plan

a. Requirements Verification

i. Detailed elaboration on Section 1.0 Part B Point i

b. Budgeting and Timeline
   i. Provide a line item budget with market values for individual components, material vendors, and applicable taxes or shipping/handling fees.
   ii. Provide a funding plan describing sources of funding, allocation of funds, and material acquisition plan
   iii. Provide a timeline including all team activities and expected activity durations. The schedule should be complete and encompass the full term of the project. Deliverables should be defined with reasonable activity duration. GANTT or milestones charts are encouraged

CDR – Critical Design Review

The CDR demonstrates that the maturity of the design is appropriate to support proceeding to full-scale fabrication, assembly, and integration; showing that the technical effort is on track to complete the flight and ground system development and mission operations in order to meet overall performance requirements within the identified cost schedule, and technical performance constraints. Progress against management plans, budget, and schedule, as well as risk assessment, are presented. The CDR is a review of the final design of all systems.

All analyses should be complete, and some critical testing should be complete. The CDR Report and Presentation should be independent of the PDR Report and Presentation. However, the CDR Report and Presentation may have the same basic content and structure as the PDR documents, but with final design information that may or may not have changed since PDR. Although there should be discussion of subscale models, the CDR documents are to primarily discuss the final design of the full-scale launch vehicle and subsystems. (NASA SL Handbook)

[Format will be provided January 2021, but is based on the NASA SL Handbook (see references)]

T/FRR – Test/Flight Readiness Review and Critical Deliverables

The T/FRR examines tests, demonstrations, analyses, and audits that determine the overall system readiness for a safe and successful ground firing/launch and for subsequent test/flight operations of the as-built equipment. It also ensures that all hardware, software, personnel, and procedures are operationally ready. (NASA SL Handbook)

[Format will be provided March 2021, but is based on the NASA SL Handbook (see references) and must be compliant with the IREC Range Standard Operating Procedures]

Manufacturing & Testing

Manufacturing and testing work will be planned in January of 2021. However, all design work should follow the dual philosophies of *design-to-manufacture* and *design-to-test*.

Here are some considerations for both design processes (not an all-inclusive list)

Design-to-Manufacture Considerations

(Manufacturing Group contact: Mohammad Chowdhury, Chief of Operations)

- Materials
    - Availability

      wood, fiberglass, aluminum, steel; some common materials

    - Material Variation / Weaves / Alloys

      whether fiberglass, wood or metals, there is much more to a material than its bulk properties

    - Workability

      we do not yet have the tools to machine solid duranium

    - Cost

      we cannot yet afford sheets of solid duranium

    - Compatibility

      with other materials or chemicals used in the system, or those with which exposure is possible

- Skills
    - Is it something we (meaning you) can learn how to do? If so, start looking into the processes *now*, not later

- Equipment
    - What tools, materials, or entirely separate designs (e.g. jigs) are needed to make the thing. Sadly, the equipment doesn't appear out of Solid Works

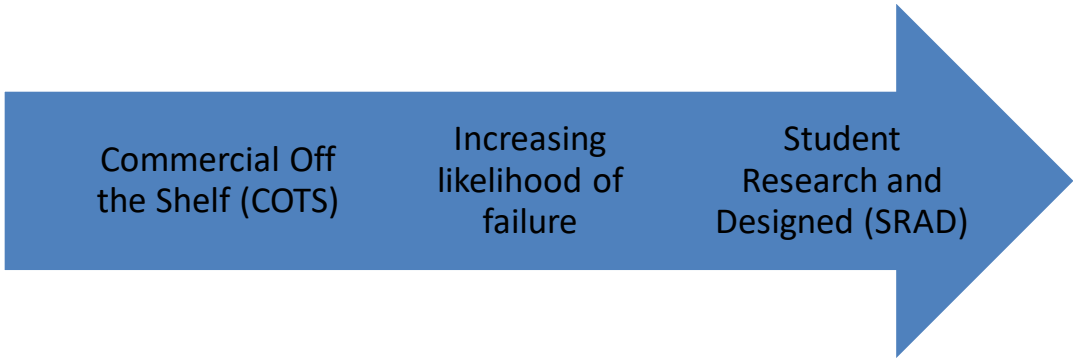
- Do we have the necessary equipment at CCNY? The answer is almost certainly yes, it is more a question of skill (see above)

Design-to-Test Considerations

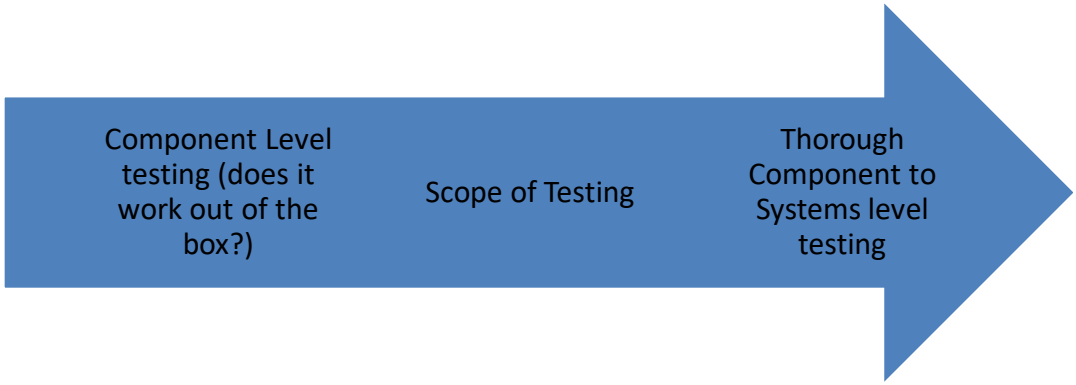
(see *Test Engineering* by Patrick O'Connor)

- Novelty
  - If a design is based on historically successful models, one can be reasonably sure a similar model will work just fine, and less testing is required
  - If a design introduces an element that has rarely or never tried before, thorough testing is required
- A Test Failure is Not a Failed Test
  - If it broke when you looked at it the wrong way it was never going to work in this place called the Real World
  - Failures contain far more useful information than successes, which can be hiding as-yet unknown design flaws
- Design work should anticipate that the system will be tested beyond its operational limits (often this is design requirement, but it is good practice even if not)
- Define the criteria of a successful test before hand

Novelty ("newness") of a Design



The Increasing Scope of Required Testing



References

Fall 2020 / Spring 2021 CCNY Academic Calendars

https://www.ccny.cuny.edu/registrar/academic-calendar

2021 SAC Integrated Master Schedule

http://www.soundingrocket.org/sa-cup-documents--forms.html

2021 NASA Student Launch Handbook

https://www.nasa.gov/stem/studentlaunch/handbook/index.html