

Friends of Amateur Rocketry - Oxidizers Uninhibited Tournament
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FAR-OUT Technical Report Instructions

Each team shall submit a Technical Report which overviews their project for the judging panel and other competition officials. The Technical Report shall be formatted using the style guide of the American Institute of Aeronautics and Astronautics (AIAA).

The main body of the technical report is not limited. Our judges will not be asked to read more than 50 pages. If you feel that to better serve as a training aid for future generations that brevity be abandoned, then we strongly encourage you to develop this document as a training aid as that is far more important than just within the scope of this competition. The main body page limit is for text only and does not include graphics. Appendices can be of any length. On or before 1 week prior to the start of the event (29 May 2024), teams shall submit a single digital PDF copy of their Technical Report. Teams shall submit the Technical Report via a link to a shared Google Drive document. For example, a team from the University of Przykład, competing in the 2024 FAR-OUT, would subtitle their Technical Report "University of Przykład Technical Report to the 2024 FAR-OUT".

ABSTRACT

The Technical Report shall contain an Abstract. At a minimum, the abstract shall identify the launch vehicle's mission/category in which the team is competing, identify the team's targeted Contract Apogee they have set for themselves, identify any unique/defining design characteristics of launch vehicle, define the payload's mission (if applicable), and provide whatever additional information may be necessary to convey any other high-level project or program goals & objectives.

INTRODUCTION

The Technical Report shall contain an Introduction. This section provides an overview of the academic program, stakeholders, team structure, and team management strategies. The introduction may repeat some of the content included in the abstract, because the abstract is intended to act as a standalone synopsis.

SYSTEM ARCHITECTURE OVERVIEW

The Technical Report shall contain a System Architecture overview. This section shall begin with a top-level overview of the integrated system, including a figure depicting the fully integrated launch vehicle and its major subsystems, configured for the mission being flown in the competition. This description shall be followed by the following subsections. Each subsection shall include detailed descriptions of each subsystem, and reflect the technical analyses used to support design and manufacturing decisions. The Technical Report should not just discuss

FAR-OUT Technical Report Instructions

what the team did, but the reasoning for their choices. These may include, but are not limited to, design goals, limitations, potential trade-offs, anticipated component loads along with safety factors. Technical drawings of these subsystems should be included in the specified appendix.

- Propulsion Subsystems
- Aerostructures Subsystems
- Recovery Subsystems
- Payload Subsystems

MISSION CONCEPT OF OPERATIONS OVERVIEW

The Technical Report shall contain a Mission Concept of Operations (CONOPS) Overview. This section shall identify the mission phases, include a figure, and describe the nominal operation of all subsystems during each phase (e.g., a description of what is supposed to be occurring in each phase, and what subsystem[s] are responsible for accomplishing this). These mission operations should include but are not limited to a discussion of pressurant and propellant remote-controlled loading, unloading, and emergency dumping or abort procedures.

Furthermore, this section shall define what mission events signify a phase transition has occurred (e.g., "Ignition" may begin when a FIRE signal is sent to the igniter and conclude when the propulsion system comes up to chamber pressure. Similarly, "Liftoff" may begin at vehicle first motion, and conclude when the vehicle is free of the launch rail). Phases and phase transitions are expected to vary from system to system based on specific design implementations and mission. The electronic version is the official, approved document. Verify this is the correct version before use. No matter how a team defines these mission phases and phase transitions, they will be used to help organize failure modes identified in a Risk Assessment Appendix.

CONCLUSIONS AND LESSONS LEARNED

The Technical Report shall contain Conclusions and Lessons Learned. This section shall include the lessons learned during the design, manufacture, and testing of the project, both from a team management and technical development perspective. If you had failures, what did you learn from them? Furthermore, this section should include strategies for corporate knowledge transfer from senior student team members to the rising underclassmen who will soon take their place.

SYSTEM WEIGHTS, MEASURES, AND PERFORMANCE DATA APPENDIX

The first Technical Report appendix shall contain System Weights, Measures, and Performance Data. All information will be reported using Imperial units (inches, feet, pounds, Newtons, etc.)

This shall include:

- Basic rocket information, including number of stages, vehicle length, airframe diameter, number of fins, fin semi-span, fin tip and root chord, fin thickness, vehicle weight, propellant weight, empty motor case/structure weight, payload weight, liftoff weight, center of pressure and center of gravity.

FAR-OUT Technical Report Instructions

- Propulsion information, including motor type, whether it is COTS or research, COTS manufacturer and designation, motor letter classification, average thrust (N), total impulse (Ns) and motor burn time.
- Rocket and GSE pressure and fluid plumbing diagrams, diagramming all valves, inlets, outlets, and their controls
- Predicted flight data including launch rail length, liftoff thrust-weight ratio (X:1), rail departure velocity, minimum static margin, maximum acceleration (G), maximum velocity, fin flutter velocity, target and predicted apogee.
- Include a flight profile graph.
- Recovery information, including the COTS and redundant altimeters used, drogue primary and backup deployment charges, drogue deployment altitude, drogue descent rate, main primary and backup deployment charges, main deployment altitude, main descent rate, shock cords and mechanical links.

PROJECT TEST REPORTS APPENDIX

The second Technical Report appendix shall contain applicable Test Reports from the minimum tests prescribed in the FAR-OUT Competition Rules and Requirements Document, found on the FAR-OUT website. These reports shall appear in the following order:

- Hydrostatic Testing/Other Pressure Vessel Testing
- Static Fire
- Electronics Testing
- Recovery Testing
- Other Fill/GSE Testing

In the event any report is not applicable to the project in question, the team will include a page marked "THIS PAGE INTENTIONALLY LEFT BLANK" in its place. The electronic version is the official, approved document.

HAZARD ANALYSIS APPENDIX

The third Technical Report appendix shall contain a Hazard Analysis. This appendix shall address as applicable, hazardous material handling, transportation and storage procedures of propellants, nominal and off nominal filling and appropriate abort procedures due to any rocket or electronic failures, and any other aspects of the design which pose potential hazards to operating personnel. A mitigation approach – by process and/or design – shall be defined for each hazard identified.

RISK ASSESSMENT APPENDIX

The fourth Technical Report appendix shall contain a Risk Assessment. This appendix shall summarize risk and reliability concepts associated with the project. All identified failure modes which pose a risk to mission success or safing of an unfired rocket shall be recorded in a matrix, organized according to the mission phases identified by the CONOPS. A mitigation approach – by process and/or design – shall be defined for each risk identified.

FAR-OUT Technical Report Instructions

ASSEMBLY, PREFLIGHT, LAUNCH, RECOVERY, AND OFF-NOMINAL CHECKLISTS APPENDIX

The fifth Technical Report appendix shall contain Assembly, Preflight, Launch, and Recovery Checklists. This appendix shall include detailed checklist procedures for final assembly, arming, launch, and recovery operations. Furthermore, these checklists shall include alternate process flows for disarming/safing the system based on identified failure modes (e.g., off nominal situations). These off-nominal checklist procedures shall not conflict with the FAR-OUT Rules and Requirements Document. Teams shall also include in this appendix a description of processes and procedures used for fill and vent procedures (including fault procedures) along with procedures for cleaning all propellant tanks and other fluid circuit components.

NOTE: These Technical Report instructions were greatly inspired by the Spaceport America Cup Project Technical Report Instructions, as that offered a fairly comprehensive overview of what a good technical report should contain. Sections required should be similar to those required by SAC, with several adjustments made to accommodate the specific goals of this competition.