2015 Rules for
AUVSI Seafarer Chapter's 13th Annual Student UAS (SUAS) Competition

FINAL

Revision 1.1

9 March 2015

The Seafarer Chapter of the Association for Unmanned Vehicle Systems International (AUVSI) will continue the Student Unmanned Aerial System (SUAS) Competition, which is aimed at stimulating and fostering interest in unmanned system technologies and careers. The focus is on engaging students in systems engineering and creating a total solution to complex problems. In other words, requiring the student teams to develop and provide the analysis, design, fabrication and demonstration of a system capable of completing specific autonomous aerial operations under specified mission time constraints.

The Seafarer Chapter and AUVSI at large are not responsible for ensuring SUAS teams operate their systems within the Federal Aviation Administration (FAA) rules and regulations. The Seafarer Chapter and AUVSI are only responsible for SUAS teams meeting FAA requirements while operating their systems during the flight-mission phase of this competition.

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1.   Executive Summary

1.1.   The competition this year will focus on the systems engineering solution employed by each team in support of the 3 major elements, system and flight mission requirements, and tasks described within these Rules. A scenario will not be provided so that the focus is on task accomplishment and innovation**.**

1.2.   Each team is expected to adhere to the deadlines provided within the Rules. The major elements that each team must accomplish include: registration, fact sheet submission, base access information, proof-of-flight (if flying), Team Check-In/Orientation, and the Safety Inspection (if flying). The three major scored events include: Technical Journal Paper, Flight Readiness Review (FRR), and Flight Mission Demonstration. The Journals are judged independently from the other events to ease competition judging logistics and to provide an opportunity for awarding prizes if the air vehicle becomes incapable of performing the mission at any point before the competition.

1.3.   The purpose of the three scored elements is to provide the means through which each team may verbally, graphically, and operationally express the team's intent to accomplish the primary and secondary tasks. In the same instance they also provide their methodology, systems engineering facets, and how they addressed the challenges they faced. Each element is structured to highlight a certain facet of the team's optimum design choices for their Unmanned Aerial System (UAS). The Technical Journal Paper focuses on the written form of communicating the team's systems engineering approach and the design, test and evaluation. The FRR addresses a team's presentation skills while focusing on analysis of testing, identification of overall safety and mission risks and their mitigation, and the overall readiness of the team's design to compete. The flight and mission relates directly to the operational performance of the vehicle and payload systems, ground and communications systems, and overall team skills and preparedness.

1.4.   Each UAS entered into this competition should be capable of completing the primary tasks before attempting secondary tasks, which provides advanced challenges. All teams and systems must perform safely and within the rules, and while operating within the required RF spectrum and without being hampered by RF co-site interference.

1.5.   Primary tasks include autonomous takeoff/landing and flight, autonomous waypoint navigation and autonomous search. There are a large number of secondary tasks that teams may attempt, following the primary tasks, to score points and prize barrels. Secondary tasks include autonomous target detection, localization and classification (ADLC), actionable intelligence, localization and localization and identification of multi-spectral sensors (EO/IR) targets, Quick Response Code (QRC) target, off-axis and emergent targets, RF message uplink/downlink, air drop delivery, network interoperability, and Sense, Detect and Avoid (SDA) tasks for introduction to the National Airspace (NAS) integration challenge. Each year these tasks change and grow. Last year IR target and air-drop deliver tasks were added, and this year the SDA task has been added. Very few teams, if any, are expected to be able to complete all tasks within the allocated mission time, so a very analytical and pragmatic approach is expected to address team's design for optimum mission performance.

2. Introduction

2.1. THRUST

2.1.1. The principal thrust of the Student Unmanned Air System (SUAS) competition is the safe application and execution of Systems Engineering principles to develop and operate an autonomous UAS to successfully accomplish the mission tasks.

2.2. GRADED ELEMENTS

2.2.1. The graded elements of this competition are:

2.2.1.1. Technical Journal Paper

2.2.1.2. Flight Readiness Review (FRR) Oral Briefing

2.2.1.3. Flight-Mission Demonstration

2.3. OPPORTUNITIES

2.3.1. Student teams will be judged based on their performance and that of their system, and top teams may earn prize money in a variety of categories. Opportunities for interaction with UAS engineers, scientists, and leadership will be provided.

2.4. RULES

2.4.1. The SUAS competition will be based upon the competition rules outlined within this document containing administrative and performance objectives. These rules are aimed at a college-level curriculum. Upon DRAFT release of these rules, potential competitors are invited to provide comments or questions prior to "University Day". After University Day, these rules may be updated with clarifications or updates and posted as the FINAL rules for competition. The SUAS committee reserves the right to make changes to these rules and issue updates or addendums at any time.

2.5. SCOPE

2.5.1. This is a performance-based competition. Multiple government agencies, prime and sub-contractors, engineering firms, and universities are observing and judging this competition. Contestants will be awarded prizes for major graded elements, overall performance, or individual aspects of a graded element.

2.6. REQUIREMENTS

2.6.1. The requirements for this competition are laid out in paragraph format, in line item numerical order, to facilitate tracking and task identification. Technical support tasks, documentation and products should be provided in accordance with these statements:

2.6.1.1. "**Shall**" indicates a requirement that is a **THRESHOLD**. Failure to meet the threshold is failure to meet the minimum criteria, i.e. failure to meet a mandatory requirement.

2.6.1.2. "**Should**" indicates a requirement that is an **OBJECTIVE**. Demonstrating these requirements will earn extra points, but the basic mission can be achieved without meeting it.

2.6.1.3. "**May**" indicates a permissible implementation, but is not a requirement.

2.6.1.4. "**Will**" indicates actions to be taken by the competition judges or other information pertaining to the conduct of the competition.

3.   Schedule

The 2015 AUVSI SUAS competition schedule is shown below in table 1.

Table 1: 2015 AUVSI SUAS Competition Schedule

Activity	Date(s)	Notes
Notice of Intent	Mon, Sept. 15, 2014	Notice Posted on Seafarer Website
Draft Rules Posted	Mon, Sept. 22, 2014	Open for written comments.
Team Written Comments	Mon, Oct. 6, 2014	**Deadline**, 11:59 PM EDT.
University Day	Thurs, Oct. 9, 2014	Conference Call-in **11:00 – 12:30 PM EDT.**
Final Rules Posted and Registration Open	Thurs, Oct. 23, 2014	Final rules. 8-week registration period starts.
Registration Closes (Application and Registration Fee Deadline)	Thurs, Dec. 18, 2014	**Deadline**, 11:59 PM EST.
Refund Registration Fee	Tues, March 31, 2015	**Deadline**, 11:59 PM EDT. Last day to withdraw and have registration fee refunded.
Team Composition Table	Tues, March 31, 2015	**Deadline**, 11:59 PM EDT.
Fact Sheet/Flight Plan	Mon, April 27, 2015	**Deadline**, 11:59 PM EDT.
Base Access Information Data/ Team Rosters	Mon, April 20, 2015	**Deadline**, 11:59 PM EDT.
Journal Paper Submission	Wed, May 20, 2015	**Deadline**, 11:59 PM EDT.
Proof of Flight Video	Wed, June 3, 2015	**Deadline**, 11:59 PM EDT.
Student Interviews (**TENTATIVE**)	Wed, June 17, 2015 9:00 AM - 4:00PM	**College Junior and Seniors**
Competition	Wed, June 17, 2015 5:00 PM EDT.	Check-in / Orientation Notice of Risk; Disclaimer of Liability; Waiver of Claims Form
	Thurs, June 18, 2015	Safety Inspections / FRR briefings
	Fri & Sat, June 19-20, 2015	Flight-Mission Demonstration
	Sat, June 20, 2015	Awards Banquet
	Sun, June 21, 2015	Rain day for flying

NOTE: Teams are encouraged to submit all items with deadlines <u>EARLY</u>. For email, the date stamp for the email will be used as the time. For posted mail, the postmark will be used as the time.

4. Major Elements of the Competition (Chronological Order)

The major elements of the competition are defined here in general terms to express the level of effort in chronological order of the competition. Further details of these elements are defined elsewhere in these rules, as noted within the description below.

4.1. NOTICE OF INTENT

4.1.1. Seafarer Chapter will issue an announcement that the chapter intends to issue the draft rules and competition schedule on a specified date.

4.2. EXPECTATIONS

4.2.1. It is expected that **ALL** teams will be present during **ALL** days of the competition. It is expected that **ALL** teams will display your vehicle and be present in the team tent in the pit area at all times (**ALL** teams, **ALL** days!).

4.2.2. Even though all forms of Commercial-off-the-Shelf (COTS) or custom parts, vehicles and software are allowed to be used, teams are responsible for adhering to all legal copyright and licensing protection.

4.2.3. A strict zero tolerance policy will be enforced for any communications or software security attacks against other team's systems or the Judges scoring software. Any attempt (successful or not) to hack any of the systems will result in the swift disqualification and removal of the team from the competition site.

4.2.4. Teams are required to operate within the United States government regulations for International Traffic in Arms Regulations (ITAR) that control the export and import of defense-related articles.

4.2.5. By participating in the SUAS competition, the team, advisors and all support members, as well as judges and volunteers, agree to have any pictures of persons, vehicles or equipment photographed and released to the public on web pages, in papers and published trade magazines and journals, or posters.

4.3. DRAFT RULES

4.3.1. The draft rules for the competition are issued in the first period of the new academic year. Professors and students are invited to review the new rules, propose changes, and form teams to participate in this student competition.

4.3.2. Teams are encouraged to review the rules and submit comments and questions to the SUAS committee before University Day. This will help the SUAS committee answer questions, clarify specific areas, and alter technical and administrative specifications as necessary.

4.4. UNIVERSITY DAY

4.4.1. University Day consists of a 1.5 hour-long conference phone call, in which all perspective competitors should participate. This event provides the opportunity to pose both general and specific questions directly to the judges.

4.4.2. Based on feedback received regarding draft rules and during University Day, these competition rules may be modified by the SUAS committee.

4.4.3. Although teams are encouraged to call in, the University Day event is not a graded element, and teams are not required to attend.

4.4.4. The date and time for University Day is listed in the Schedule of Section 3.

4.4.5. The conference call number and web meeting URL are defined in Section 10.1.7.

4.5.   **FINAL RULES**

   4.5.1.   The final rules will be posted after University Day -- at least eight weeks before the deadline for submission of the applications and registration fee.

   4.5.2.   Details about the release of the final rules are found in the Schedule in Section 3.

   4.5.3.   It is intended that the final requirements remain fixed. However, the SUAS committee reserves the right to make changes as deemed necessary.

   4.5.4.   Any changes to the final rules after the release date will be posted to the official competition website as a revision and the Team Captain will be notified.

4.6.   **REGISTRATION PROCESS**

   4.6.1.   A completed registration application form and the full registration fee **shall** be received in order for a team to begin the qualification process to enter this competition.

   4.6.2.   The registration process will open at the same time the final rules are posted.

   4.6.3.   To be accepted and processed, the registration application form and payment **shall BOTH** be received with official postmark, bank annotation or electronic file date/time stamped for submission no later than the deadline stated.

   4.6.4.   Registration application form (typed, no hand-written entries) and payment **shall** be submitted by the specified date and time deadline detailed in the Schedule of Section 3.

   4.6.5.   Details about the registration process are found in Sections 10.2 thru 10.4. The required registration application form is located in Appendix A: Registration Application Form.

4.7.   **DOWN-SELECTION**

   4.7.1.   Due to the large number of teams interested in competing, the SUAS committee reserves the right to implement a down-selection process. This may restrict teams from participating in a single or multiple phases of the competition, based on requirements laid out in these rules.

   4.7.2.   A down-selection process may occur at any time, even after the withdraw deadline.

   4.7.3.   Details about the down-selection process are in defined Section 10.6.

   4.7.4.   Teams **shall** complete all required items as soon as possible to avoid down selection due to content or schedule.

4.8.   **REFUND REGISTRATION FEE DEADLINE**

   4.8.1.   There is a deadline for the last day a team may formally request to be withdrawn from the SUAS competition and be reimbursed the registration fee.

   4.8.2.   Withdrawal **shall** be requested before the deadline detailed in the Schedule of Section 3 in order to receive reimbursement.

   4.8.3.   Failure to properly withdraw from the competition by the deadline will result in forfeiture of the registration fee.

   4.8.4.   Details about the withdraw process are defined in Section 10.5.

4.9.   **FACT SHEET**

   4.9.1.   After being accepted into the competition, a fact sheet providing basic descriptions of the aircraft and systems **shall** be submitted to AUVSI Seafarer Chapter. As this is

the first introduction to a team's system, the fact sheet **shall** provide necessary data for logistics and safety. The Fact Sheet **shall** inform the SUAS committee and judges of general vehicle parameters for safety purposes such as vehicle size, weight, fuel or battery type, transmitted aircraft control and payload data frequencies, and large ground equipment that will be transported to the flight line. This year the Fact Sheet shall include the flight plan table to improve both team and judge's preparations. The Fact Sheet is now a 2-page submission, as defined in Appendix B.

4.9.2.   The Fact Sheet due date will be used as the first down select filter, with the content of the fact sheet being secondary.

4.9.3.   The Fact Sheet (with flight plan table) **shall** be submitted by the specified date and time deadline detailed in the Schedule of Section 3.

4.9.3.1.   Late submissions of the Fact Sheet may not be accepted. If requested in writing by a team captain and authorized by the Head Judge, late submission may only be accepted up to 5 days after the deadline. Each day late will result in points deducted from the team's score for the flight-mission demonstration phase of the competition.

4.9.3.2.   Failure to submit the Fact Sheet by the 5th day post deadline will result in disqualification from the flight-mission demonstration phase of the competition.

4.9.3.3.   The Fact Sheet deadline is past the withdrawal date, so NO refunds will be processed for teams that fail to participate after the extended timeframe.

4.9.4.   The Fact Sheet submitted **shall** generally follow the suggested two (2) page format provided in Appendix B: Fact Sheet and Flight Plan Table.

4.9.5.   The Fact Sheet **shall** be typed (no hand-written entries) and shall be electronically submitted in PDF file format.

4.9.6.   The Fact Sheet's filenames **shall** include the school and team name, abbreviated as needed, and have the prefix "FS" (capital letters "FS" will identify the file as the Fact Sheet, which must be different from the journal paper filename).

4.9.7.   Each registered team will be provided explicit instructions on how to log in and upload the Fact Sheet to the team's unique folder on the SUAS SharePoint site.

4.10. **BASE ACCESS INFORMATION**

4.10.1.   Prior to the competition, the registered teams **shall** submit the required personal data and information for all team members in the form of a complete team roster and individual identities to be reviewed for base access.

4.10.2.   Teams from U.S. schools **shall** provide the necessary data in order to access a military base detailed in Section 10.

4.10.3.   Teams from schools outside the U.S., or U.S. teams with non-U.S. citizens, **shall** provide additional specific data and formal letters of authority from their school in order to access a military base detailed in Section 10.

4.10.4.   Security associated with the Navy's military base may require the SUAS competition limit the number of non-U.S. citizens able to access the base.

4.10.5.   The base access information is required to participate in oral presentation and flight-mission phases of the competition.

4.10.6.   The base access data **shall** be submitted by the specified date and time deadline detailed in the Schedule of Section 3.

4.10.7.   The base access **shall** be submitted in accordance with the details in Section 10.

4.11. **PROOF-OF-FLIGHT**

4.11.1.   Prior to the competition, a proof-of-flight video **shall** be submitted as proof that the team's aircraft can attain, sustain, and land in a safe manner, independent of the mission systems.

4.11.2.   The proof-of-flight video does not need to have the aircraft in a full-up mission flight configuration. It is acceptable to demonstrate a Radio Controlled (RC) flight (at expected competition takeoff weight).

4.11.3.   The proof-of-flight video **shall** provide the following:

4.11.3.1.   Identify the school and the competition year.

4.11.3.2.   Show the vehicle in the following phases of flight:

4.11.3.2.1.   Takeoff

4.11.3.2.2.   Flight

4.11.3.2.3.   Landing (crashes or unintentional off-field landings do not count)

4.11.4.   A backup vehicle may be used for the flight-mission demonstration, but a separate proof-of-flight video **shall** be required to be submitted within the same deadline.

4.11.5.   The proof-of-flight video **shall** be uploaded to the competition SharePoint site (see SharePoint instructions in Section 10.1.4) as a text file containing a link to the team's video posted on the internet (www.youtube.com is preferred, but other means of multi-media distribution may be accepted)

4.11.6.   The proof-of-flight video is required to participate in the flight-mission demonstration phase of the competition.

4.11.7.   The proof-of-flight video **shall** be submitted by the specified date and time deadline detailed in the Schedule of Section 3.

4.11.7.1.   Late submissions of the proof-of-flight video may not be accepted. If requested in writing by a team captain and authorized by the Head Judge, late submission may only be accepted up to 5 days after the deadline. Each day late will result in a significant points deducted from the team's score for the flight-mission demonstration phase of the competition.

4.11.7.2.   Failure to submit the proof-of-flight video by the 5th day post-deadline will result in disqualification from the flight-mission demonstration phase of the competition.

4.11.7.3.   The proof-of-flight video deadline is past the withdrawal date, so NO refunds will be processed for teams who do not participate after the extended timeframe.

4.12. **JOURNAL PAPER**

4.12.1.   Each team **shall** submit a technical journal paper that describes the design of their entry and the rationale behind their design choices. The purpose of the paper is to show the team's overall systems engineering process, design tradeoffs, final design solution for the system, illustrate how it will safely perform mission tasks, and

provide test results verifying same. The journal paper **shall** address the mission tasks the team may be capable of achieving during flight.

4.12.2.   The journal paper **shall** be a graded element.

4.12.3.   The journal paper **shall** be submitted by the specified date and time deadline detailed in the Schedule of Section 3.

4.12.3.1.   Late submissions of the journal paper may not be accepted. If requested in writing by a team captain and authorized by the Head Judge, late submission may only be accepted up to 5 days after the deadline. Each day late will result in a significant points deducted from the team's score for the journal paper phase of the competition.

4.12.3.2.   Failure to submit the journal paper by the 5th day post-deadline will result in disqualification from the competition.

4.12.3.3.   The journal paper deadline is past the withdrawal date, so NO refunds will be processed for teams who fail to participate after the extended timeframe.

4.12.4.   Details about the journal paper requirements are found in Section 8 Scoring Metrics.

4.12.5.   The journal paper **shall** be submitted by uploading it to the team's SharePoint folder defined in Section 10.1.4.

4.12.6.   The journal paper's filenames **shall** include the school and team name, abbreviated as needed, and have the prefix "JP" (capital letters "JP" will identify the file as the journal paper, which must be different from the fact sheet filename).

4.13.   **STUDENT INTERVIEWS (TENTATIVE)**

4.13.1.   Folders will be created on the SUAS SharePoint site where registered students may post their resumes for review by premium level SUAS sponsors.

4.13.2.   Interviews may be arranged between college students and premium level SUAS sponsors at the specified date and time detailed in the Schedule of Section 3.

4.13.3.   Planning details will be broadcast to registered teams once the details mature so that timely coordination can occur.

4.13.4.   Students are still expected to arrive at the Team Check-In and Orientation without interruption caused by interviews.

4.13.5.   Students are encouraged to use AUVSI's Online Career Center at http://careers.auvsi.org.

4.14.   **TEAM CHECK-IN AND ORIENTATION**

4.14.1.   During check-in teams will receive instructions, badges and vehicle passes for base access.

4.14.2.   During the check-in process all students, academic advisors, and visitors **shall** sign the appropriate liability waiver form defined in Section 9 and Appendix H.

4.14.3.   During the orientation teams will receive up-to-the-minute changes in plans and be provided reminders about rules and coordination. Teams will also be notified of the initial order for conducting the oral presentations the following morning.

4.14.4.   A simple meal will be provided for the students during the check-in process.

4.14.5.   The mission waypoint GPS coordinates and altitudes will be supplied to the Team Captains at the end of check-in and orientation.

4.14.6.　　Team **shall** be at the check-in and orientation briefing at the specified date and time detailed in the Schedule of Section 3.

　　　　4.14.6.1.　There is no guarantee that a team will be processed into the competition if they are unable to make all the deadlines detailed in the Schedule of Section 3.

　　　　4.14.6.2.　Teams not in attendance for the check-in and orientation briefing **shall** risk being unable to access the government facility and forfeit their ability to compete.

　　　　4.14.6.3.　If the team encounters unforeseen circumstances during travel that affect arrival schedules and cause them to miss the check-in and orientation briefing, the Team Captain or alternate **shall** make every effort to contact the SUAS Competition Director prior to check-in start time. They will need to explain the circumstances and request exemption from attendance at check-in. They will be provided guidance on how to undergo a late check-in process.

4.14.7.　　The location of the check-in and orientation are defined in Section 10.1.9.

4.15.　SAFETY INSPECTIONS

4.15.1.　　Safety inspections **shall** include a physical inspection, fail-safe check, flight termination check, and a maximum weight check.

4.15.2.　　Safety inspections **shall** be performed on all aircraft by designated competition safety inspectors prior to being allowed to make any competition or non-competition (i.e., practice) flight.

4.15.3.　　The safety inspections are not a graded element. All decisions of the safety inspector(s) **shall** be final.

4.15.4.　　The safety inspections **shall** be performed on the specified date detailed in the Schedule of Section 3.

4.15.5.　　Details about the safety inspection process are defined in Section 9.5.

4.15.6.　　Questions regarding conduct of the safety inspection may be sent to the SUAS Safety Inspector contact detailed in Section 10.1.8.

4.15.7.　　The location of the safety inspection is defined in Section 10.1.10.

4.16.　FLIGHT READINESS REVIEW (FRR) BRIEFING & STATIC DISPLAY

4.16.1.　　The Flight Readiness Review (FRR) **shall** be an oral briefing presented to a team of judges during which the teams substantiate, with data, their plans to safely accomplish the mission.

4.16.2.　　The intention is to demonstrate to the judges that the team is ready to compete safely, with low risk, in the flight-mission demonstration phase of the competition. The FRR should not merely be a restatement of the technical journal paper. The FRR **shall** address the mission tasks the team plans to achieve during flight.

4.16.3.　　Following the FRR briefing's question and answer period, the judges **shall** perform a brief review and inspection of the team's UAS including aircraft exterior and interior, ground station, test data, safety checklists, and other supporting evidence.

4.16.4.　　The FRR briefing will be conducted in an open-air environment with only minimal protection from sunlight, wind and/or rain, and ambient noise. The teams **shall** come prepared to speak loudly and deal with a noisy, outdoor environment.

4.16.5.   All team members present are encouraged to participate.

4.16.6.   The FRR briefing and static display are graded elements of the oral presentation.

4.16.7.   The static display **shall** include visual aids and the actual system being demonstrated, to support and clarify the team's briefing.

4.16.8.   Teams are encouraged to leave certain aspects of their static display up for sponsors to see the work accomplished and for other teams to ask questions.

4.16.9.   The FRR **shall** be given on the date detailed in the Schedule of Section 3.

    4.16.9.1.   The FRR date is past the withdrawal date, so NO refunds will be processed for teams who fail to participate.

4.16.10.   Details about the FRR requirements are found in Section 8 Scoring Metrics.

4.16.11.   The location of the FRR is defined in Section 10.1.10.

4.17.   **FLIGHT-MISSION DEMONSTRATION**

4.17.1.   The flight-mission demonstration evaluates the teams' ability to conduct a mission operation with their vehicle. This is the culminating event of the competition.

    4.17.1.1.   Only teams who submit a Fact Sheet and Journal Paper, and successfully pass the FRR and Safety Inspection, **shall** be allowed to fly.

4.17.2.   Each team **shall** arrive prepared to immediately begin flight operations.

4.17.3.   Flight demonstrations **shall** follow procedures briefed the day before during FRR.

4.17.4.   A lead judge will be assigned to each team at the flight line. There will be additional judges assigned who are focused on different aspects of the competition (imagery, autonomy, safety, etc.) depending upon which tasks the team is planning to accomplish.

4.17.5.   The flight-mission demonstration will be conducted on an active runway. It is important that all team members follow the instructions of the judges and the SUAS committee. Teams that repeatedly fail to follow instructions **may be disqualified**.

4.17.6.   The flight-mission demonstration is a graded element.

4.17.7.   The flight-mission demonstration has specified dates, and a back-up rain date, detailed in the Schedule of Section 3.

    4.17.7.1.   <u>Note</u>: if weather interferes with the scheduled dates for flight-mission demonstration, teams may be scheduled to fly on the back-up rain date, which is Sunday.

    4.17.7.2.   The flight-mission demonstration dates are past the withdrawal date, so NO refunds will be processed for teams who fail to participate.

4.17.8.   Details about the flight-mission demonstration requirements are found in Sections 6 and 7 of these rules.

4.17.9.   The location of the flight-mission demonstration is defined in Section 10.1.10.

4.17.10.   Each team should anticipate a crowd of judges and media at the flight line. Teams are encouraged to actively control their team on the flight line and around their operational area.

4.18.   **COMPETITION PHOTO**

4.18.1.   All teams, advisors, judges and volunteers are requested to stay at the competition site until the very last team has flown to show support for all teams and ensure maximum exchange of information among teams and students.

4.18.2.   After the last flight all teams and advisors are encouraged to gather with their aircraft, along with all the judges and volunteers, for a Competition photograph.

4.19.   **AWARDS BANQUET**

4.19.1.   The awards banquet includes a dinner and a keynote speaker, followed by the presentation of awards. The final standings of the competition will be announced during the presentation of awards and cash prizes.

4.19.2.   Sponsors and industry members will be at the banquet.

4.19.3.   Teams are strongly encouraged to attend this banquet.

4.19.4.   Recommended attire for the banquet is business casual (collared shirts and slacks).

4.19.5.   The awards banquet's date and time are detailed in the Schedule of Section 3.

4.19.5.1.   If a rain delay causes the competition to fly on Sunday, the awards banquet will still be held on Saturday, although only awards for journal papers and oral presentations will be awarded. The flight demonstration and final standings of the competition will be announced at a later time.

5.   System Requirements

This section lists system requirements or limitations that are not otherwise covered in the task descriptions.

5.1.   AIRCRAFT REQUIREMENTS

5.1.1.   The system **shall** be limited to one aircraft in the air at any time.

5.1.2.   The air vehicle **shall** be capable of heavier-than-air flight.

5.1.3.   The aircraft may be of any configuration except lighter-than-air, **shall** be free-flying, and **shall** have no entangling encumbrances such as tethers.

5.1.4.   To earn points, and in some cases be allowed to compete, the air vehicle **shall** be capable of autonomous flight and navigation required to meet the minimum thresholds of the primary tasks defined in Section 7.

5.1.5.   To earn additional points the air vehicle payloads **shall** be capable of meeting the minimum thresholds of the secondary tasks defined in Section 7.

5.1.6.   The aircraft **shall** comply with the Safety Regulations described in Section 9.

5.1.7.   The team's **shall** not deploy or employ ground based sensors on the runway, taxiway or airfield other than the immediate area around their flight-line tent.

5.1.8.   Launchers will be inspected by competition safety inspectors before they are allowed for use in the competition. Safety inspection is covered in Section 9.5.

5.2.   GROUND STATION REQUIREMENTS

5.2.1.   To earn points, and in some cases be allowed to compete, the ground station **shall** be capable of meeting the minimum thresholds of the tasks defined in Section 7.

5.2.2.   The system **shall** output position target data (location & characteristics) in accordance with the format defined in Section 7.

5.2.3.   The judges **shall** be able to view the safety-of-flight information on the ground control system displays at all times, including in bright sunlight conditions.

5.2.4.   Teams may bring their own ground based sensors, but are restricted to locating the sensors at the team's tent at the flight line or in the pit area. No antenna masts, balloons, or other obstacles on the airfield taller than the flight line tents (approximately 10-12 ft.) will be permitted.

5.2.5.   Teams **shall** NOT use any other means to collect imagery (including using other teams' systems).

5.2.6.   The ground control system **shall** not exceed more than one motor vehicle and one trailer at the flight line.

5.3.   RF COMMUNICATIONS REQUIREMENTS

5.3.1.   The SUAS competition **shall** allow multiple teams to transmit on Wi-Fi (2.4/5.8GHz), (except for 900 MHz) on multiple Radio Frequency (RF) communications bands at the same time. This is intended to provide teams additional setup/troubleshooting time as well as improve the efficiency of the competition and requires teams to seriously address RF system design.

    5.3.1.1.   In the event that unforeseen <u>safety</u> issues arise in executing simultaneous teams transmitting RF, the competition reserves the right to revert to one team transmitting RF at a time or other measures.

        5.3.1.1.1.   Systems should be designed for this contingency. If the competition reverts to one team transmitting RF halfway through flight demonstrations, there will be no re-flights for teams who previously flew their mission.

5.3.2.   Systems **shall** be designed such that multiple systems can operate simultaneously using a RF spectrum management scheme described below. Use of any communication frequencies not described **shall** be prohibited unless the details are clearly defined in the Fact Sheet submitted and the team has received written authorization from the SUAS Competition Director or Head Judge.

    5.3.2.1.   Systems that do not comply with these requirements may be prohibited from operating on unapproved frequencies.

    5.3.2.2.   Manufacturer name, model numbers and Specifications (frequencies, bandwidths, channels, etc.) on the equipment of all RF transmitters and receivers **shall** be provided in the Fact Sheet.

5.3.3.   Teams are strongly encouraged to consider use of all forms of hardwired RF interface cables and/or antenna 'hats' to connect the aircraft's RF systems to the ground station's RF elements during operational checkout and troubleshooting on the ground to avoid conflicting with RF transmission restrictions on or off the airfield.

5.3.4.   <u>Frequency management concept</u>. Frequency management and control is being pushed onto the teams, more akin to real-world operations. Teams **shall** not use radio "default" settings. Use of encryption, directional antennas, RF filters, RF amplifiers, etc. is highly encouraged. It is expected that teams come prepared with fallback plans.

5.3.5.   Specific frequency management requirements for each band:

    5.3.5.1.   <u>72 MHz:</u> The use of 72 MHz for RC control is strongly discouraged; however, teams with existing systems using 72 MHz RC **shall** provide specific channel information in the Fact Sheet (including channel selection capabilities). Earlier notification is highly desirable. Coordination of use of channels within 72 MHz RC control will be managed on a case-by-case basis during competition.

    5.3.5.2.   <u>433 MHz:</u> Use of UHF ISM Band 433MHZ (431-435MHZ) **shall** be limited to use of Frequency Hopping Spread Spectrum technology.

    5.3.5.3.   <u>462.7 MHz:</u> Handheld radios on General Mobile Radio Service (GMRS) will be operated by the competition staff in close proximity to aircraft and ground stations.

        5.3.5.3.1.   Note: Teams should consider using RF filters in their equipment to prevent interference from GMRS radios.

    5.3.5.4.   <u>900 MHz:</u> ISM b Output Frequency is CONTROLLED. Teams will be granted approval for 900MHz only one at a time on the flight line during the mission flight-demonstration.

        5.3.5.4.1.   Unauthorized transmission on 900MHz without permission to transmit **shall** be prohibited. This includes wireless operation in the pits/spectator area. Repeated offenders may be excluded from further participation in the competition.

5.3.5.5. 1.08, 1.12, 1.16, 1.2, 1.24, 1.28, 1.32, and 1.36 GHz: Limited to use of Frequency Hopping Spread Spectrum technology.

5.3.5.6. 1.2 - 1.3 GHz: Limited to analog or digital video systems.

5.3.5.7. 2.4 GHz RC (2.4- 2.485 GHz): Spread Spectrum techniques in accordance with FCC regulation CFR 47 part 15.

5.3.5.8. 2.4 GHz Wi-Fi (802.11 b/g/n): Use of 2.4 GHz Wi-Fi **shall** be OPEN.

5.3.5.9. 5 GHz Wi-Fi (802.11a/h/j/n/ac): Use of 5 GHz Wi-Fi **shall** be OPEN.

5.3.5.10. Use of cellular and mobile Wi-Fi will not be restricted.

5.3.5.10.1. NOTE: Cellular reception at the competition site is poor and unreliable.

5.3.6. 802.11 wireless (a/b/g/h/i/n) **shall** have an SSID of the team's school and/or team name (e.g. BobUniversity) for quick and easy identification. The team's SSID **shall** be provided in the Fact Sheet and **shall** not change during competition.

5.3.6.1. Any 802.11 wireless system **shall** have over-the-air encryption (WPA, WEP, or otherwise) enabled.

5.4. ELECTROMAGNETIC ENVIRONMENTAL EFFECTS (E^3) REQUIREMENTS

5.4.1. The SUAS committee will NOT attempt to prevent airfield electromagnetic emissions except for in the 900 MHz band. The teams' systems should incorporate basic electromagnetic interference (EMI) and electromagnetic compatibility (EMC) design considerations.

5.4.2. The SUAS teams should monitor all RF frequencies and channels at the flight line and in the pit area to identify any specific RF signals at the airfield that may interfere with their own systems. The teams should use this data to avoid operating in specific channels the teams may feel are problematic for their own system's operating frequencies. The SUAS committee will also be monitoring all RF frequencies and channels to identify any specific RF signals at the field, but the teams should not solely rely on this monitoring.

5.4.3. Teams should also anticipate that numerous mobile and wireless devices (phones, PDAs, computers, GoPro cameras, etc.) will be operating on the airfield that will not be controlled.

5.4.4. Any team found to be intentionally jamming another team during flight operations will be eliminated from the competition.

5.5. WEATHER REQUIREMENTS

5.5.1. Teams **shall** be able to compete in the following conditions:

5.5.1.1. The aircraft **shall** be capable of takeoff and landing in crosswinds to the runway of 8 knots with gusts to 12 knots (when using the most favorable runway/direction for runway dependent systems). Two runway options of approximately 90 degrees apart are available.

5.5.1.2. The aircraft **shall** be capable of operating during all mission phases in tower reported surface winds of 15 knots with gusts to 20 knots.

5.5.1.3. The system **shall** be capable of completing mission objectives in surface temperatures up to 110 degrees Fahrenheit.

5.5.1.4. The system **shall** be cable of completing the mission after exposure to temperatures of 100 degrees Fahrenheit for up to 12 hours.

5.5.1.5.   The system **shall** be capable of operating in fog conditions of visibility of 2 miles or greater with no precipitation.

5.5.2.   If conditions fall outside weather requirements, or if the judges feel environmental conditions are unsafe (such as approaching thunderstorms), the competition will be suspended.

5.5.3.   The aircraft and ground station should be easily secured during windy conditions, and any sensitive electronics or components of high value should be able to be rapidly protected from rain in short notice (e.g. cases or tarpaulins).

5.6.   **PIT AND AIRFIELD PROVISIONS**

5.6.1.   In the pits and at the airfield, the SUAS committee will ensure the teams are provided a tent for shade, a folding table, chairs, and a single electrical power extension cord from a mobile generator.

5.6.2.   The electrical power provided will be 115 VAC, 60 Hz, rated up to 15 amperes.

5.6.3.   Although rare, there is a possibility the mobile generator may run out of gas at any time during the competition and not be refilled and restarted for some undetermined period of time. Teams **shall** be capable of operating in the field without electrical power provided by the competition for up to 10 minutes. The Lead Judge **shall** give consideration to teams who are on Mission Clock during an unplanned electrical power outage until such time as power is restored.

5.7.   **Airfield Notes**

5.7.1.   Airfield coordinates: 38°09'01.5"N, 76°25'29.7"W

5.7.2.   Airfield elevation is 22 feet MSL.

5.7.3.   Airfield magnetic deviation is 11 degrees west.

5.7.4.   The runway is a paved asphalt surface, roughly 100 feet wide, with no height obstacles.

5.7.5.   Grass areas within the takeoff/landing area will not be prepared.

5.7.6.   A map of the competition area is shown in Appendix C (from 2014 SUAS and is only for an example).

6. Flight-Mission Demonstration Requirements

6.1. **FLIGHT TASKS**

    6.1.1.   Only systems in the proof-of-flight video, presented in the FRR, inspected by safety inspectors, and included in the preflight brief will be permitted to fly.

6.2. **OPERATIONAL TIMELINE**

    6.2.1.   Timeline Increments

        6.2.1.1.   The SUAS committee reserves the right to adjust the time for these segments at any time of the overall competition evolution. The value of a minute of mission time will not be provided to student teams.

    6.2.2.   Transportation to Flight Line

        6.2.2.1.   Specified Time = <u>10 minutes maximum</u>

        6.2.2.2.   Each team **shall** have a maximum specified period of time to transport their system from the staging area to the flight line upon notification (and, if requested, availability of competition-provided transportation).

    6.2.3.   Setup Time

        6.2.3.1.   Specified Time = <u>20 minutes maximum</u>

        6.2.3.2.   Each team **shall** have a maximum specified period of time to set up equipment on the flight line prior to starting their mission clock. After the maximum setup time has elapsed, the judges may declare mission start, regardless of the team's readiness to launch the mission. If another team is on the mission clock, the team on setup may benefit from additional time before being called to start their mission time.

        6.2.3.3.   Setup time begins when the team arrives at the flight line. A lead judge will be assigned to each team and will start a dedicated stopwatch after communicating with the Team Captain.

        6.2.3.4.   During set up, teams **shall** abide by the RF transmitting rules specified in Section 5.3.

        6.2.3.5.   A pre-mission briefing **shall** be accomplished prior to flight. This briefing is to inform the judging team of:

            6.2.3.5.1.   The structured flight operations.

            6.2.3.5.2.   Safety, including the process for manual override and the process for activating the FTS.

            6.2.3.5.3.   The tasks the team plans to attempt.

        6.2.3.6.   The pre-mission briefing **shall** be accomplished during setup time and will not be counted against Mission Time.

    6.2.4.   Mission Time

        6.2.4.1.   Mission Time (T_M) = 60 minutes absolute maximum

        6.2.4.2.   Mission Time is split into two (2) separate periods: Flying Time plus Post Processing Time. The total Mission Time is scored, while the two periods allow for bonus or penalties points, or termination of scoring.

            6.2.4.2.1.   Mission Time equals the Flying Time until the team either stops occupying the airfield and runway or the judge terminates the mission.

6.2.4.2.2. After ending the Flying Time, the Mission Time may seamlessly continue into the Post Processing Time.

6.2.4.3. Bonus points may be scored for ending Flying Time period early.

6.2.4.4. Mission Time **shall** start at the declaration of Mission Clock start from the Lead Judge, who will have a dedicated Mission Clock stopwatch.

6.2.4.5. Mission Time **shall** stop/end once one of the following occurs:

6.2.4.5.1. Standard: The vehicle has ended its flight (landed, crashed, or terminated), and both the aircraft and team members are back at the team's tent and off the runway, and 900 Hz transmitters are off, and all scoring materials are turned into the Lead Judge.

6.2.4.5.2. Timeout: A Timeout is called by the Team Captain and the **Timeout criteria are met (section 6.2.6)**. If the Mission Clock is started again after Timeout the elapsed Mission Time will be counted.

6.2.4.5.3. Judge's Call: The Lead Judge declares the Mission Time stopped or terminates the mission due to rules/safety.

6.2.4.6. Flying Time:

6.2.4.6.1. Flying Time = 40 minutes maximum

6.2.4.6.2. Flying Time is the first period of the Mission Clock and constitutes time the team is occupying the runway and airspace and allowed to transmit on 900 MHz band.

6.2.4.6.3. During Flying Time teams **shall** be permitted to radiate RF (including 900 MHz band), run propulsion systems, and use the active runway and airfield.

6.2.4.6.4. A team may elect to cycle through the takeoff and landing sequence during the Flying Time more than once for a variety of valid reasons (change batteries, etc.). No points will be lost, but critical mission time will be consumed.

6.2.4.6.5. Flying Time starts with the beginning of the Mission Clock and the amount of Flying Time **shall** be scored.

6.2.4.6.6. Flying Time stops (see 6.2.4.5) when the vehicle has completed flight (landed, crashed, or terminated), and the aircraft and team no longer occupies the active airfield or runway, and the team has turned off 900MHz transmitters. The Lead Judge will confirm with the Team Captain the Flying Time period has stopped and the Post Processing Time period starts.

6.2.4.6.7. Flying Time = 20 minute termination: If the aircraft has not achieved flight by this elapsed Mission Time, the mission will be terminated by the Lead Judge and no further scoring is possible.

6.2.4.6.8. <u>20 <= Flying Time < 30 minutes</u>: Bonus points will be scored if the team no longer occupies the active airfield or runway of roughly one-half a target at objective level per minute.

6.2.4.6.9. <u>30 <= Flying Time < 40 minutes</u>: Teams occupying the active airfield or runway during this time **shall** be assessed a penalty of roughly one-half a target at objective level per minute.

6.2.4.6.10. <u>Hard Limit (Flying Time)</u>: (see 6.2.4.6.1) If teams reach maximum Flying Time and still occupies the active airfield or runway (even if the aircraft is on approach), the Lead Judge will terminate the Mission Clock and teams **shall** have no further opportunity to provide data for scoring. This is a **hard limit and will be enforced** (intended to give all teams an opportunity to fly).

6.2.4.7. Post-Processing Time

6.2.4.7.1. Post Processing Time = <u>20 minutes maximum</u>

6.2.4.7.2. Post Processing Time is an optional second period of Mission Time that can be used without penalty. This time is dedicated to post-processing to both better utilize the airfield and to improve the quality of each teams' imagery data.

6.2.4.7.3. The Team Captain **shall** notify the Lead Judge if Post Processing Time is planned during the pre-mission brief. The Lead Judge will announce when the Flying Time has stopped and the Post Processing Time starts.

6.2.4.7.4. <u>Post-Processing Time starts</u> immediately after the Flying Time stops.

6.2.4.7.5. <u>Post-Processing Time stops</u> when the Team Captain hands in the scoring sheets which ends Mission Time, or if the maximum Post Processing Time is exceeded and the Lead Judge terminates scoring.

6.2.4.7.6. <u>Hard Limit (Post-Processing Time)</u>: At the maximum Post Processing Time, the Lead Judge will immediately stop the Mission Clock and no further opportunities for scoring will be given. Teams **shall** hand in all scoring material prior to the hard limit. This is a **hard limit and will be enforced**.

6.2.5. Teardown Time

6.2.5.1. Specified Time = <u>10 minutes maximum</u>

6.2.5.2. The system **shall** be disassembled and transported off of the flight line within a maximum specified amount of time from the end of the mission (or post-processing time if used).

6.2.5.2.1. The judges may give the team a post-flight debriefing immediately following the mission or post-processing time, before the teardown clock is started.

6.2.5.3.   Transportation to the pits will be provided, if requested.

6.2.6.   Timeouts

6.2.6.1.   Each team **shall** only be allowed one Timeout to stop the Mission Clock.

6.2.6.2.   Two types of timeout **shall** be allowed: Timeout-in-Place or Timeout-in-the-Pits.

6.2.6.3.   A Timeout-in-the-Pit may be taken anytime up until first takeoff. After first takeoff only Timeout-in-Place **shall** be allowed.

     6.2.6.3.1.   Once a team has completed a Takeoff maneuver, ONLY a Timeout-in-Place **shall** be permitted (to prevent teams from potentially taking imagery data back to the pits).

6.2.6.4.   Timeouts **shall** not be available during transport to the flight line or during set-up.

6.2.6.5.   Teams can land and change configuration more than once, but must stay on the Mission Clock.

6.2.6.6.   RF transmission in the 900 MHz band **shall** not be performed during a Timeout.

6.2.6.7.   Data processing **shall** not be performed during Timeouts.

6.2.6.8.   Use of a Timeout **shall** incur penalty points.

     6.2.6.8.1.   The penalty for Timeout-in-the Pits is equivalent of 3 targets at objective level.

     6.2.6.8.2.   The penalty for Timeout-in-the Place is equivalent of 1.5 targets at objective level.

     6.2.6.8.3.   Team **shall** not perform data or image processing or transmitting in the 900 MHz band during a Timeout or risk disqualification.

6.2.6.9.   <u>Timeout-in-Place</u> = 10 minutes minimum

     6.2.6.9.1.   A team may elect to take a Timeout-in-Place once on the flight line. This **shall** guarantee the team a minimum amount of time at the flight line (not occupying the airfield or runway), off the Mission Clock.

6.2.6.10.   <u>Timeout-in-the-Pit</u> = Allocated time depends on many random circumstances.

     6.2.6.10.1.   A team may elect to take Timeout-in-the-Pit.

     6.2.6.10.2.   Teams should call Timeout-in-the-Pit any time before being transported to the flight line.

     6.2.6.10.3.   Any team that takes a Timeout-in-the-Pit **shall** move to the back of the flight queue and may not have another opportunity to fly. All teams who have not yet been called to the flight-line **shall** be given an opportunity to fly before teams who have called this Timeout.

     6.2.6.10.4.   All teams who have taken a Timeout-in-the-Pit **shall** be re-called in random order. If there is not enough time to fly all teams who took a Timeout-in-the-Pit, the judges will assess if any team will be called back to the flight line.

6.2.6.11. Calling a Timeout

6.2.6.11.1. Only the Team Captain **shall** call time-out. The announcement **shall** be made clearly to the Air Boss (in the Pits) or Lead Judge (on flight line). The Lead Judge will confirm the call before the Mission Clock is stopped.

6.2.6.11.2. The type of timeout **shall** be announced when the Team Captain makes the call and cannot be changed.

6.2.6.11.3. Timeout notification may be made anytime, but the Timeout **shall** NOT begin until the Air Boss notifies the Lead Judge (Timeout in the Pits) or the Lead Judge has stopped the Mission Clock (Timeout in Place).

6.3. **MISSION LIMITATIONS**

6.3.1. Mission Boundaries

6.3.1.1. During the entire mission, aircraft **shall** remain in controlled flight and within the no-fly-zone boundary. A specific no-fly-zone boundary definition will be provided to teams at the Check-in and Orientation. Any vehicle appearing uncontrolled or moving beyond the no-fly-zone boundary will be subject to immediate manual override. Failure of manual override will result in flight termination.

6.3.1.2. Points will be deducted for flying in no-fly-zones. Examples of no-fly-zones are shown on the Competition Map (*Example*) of Appendix C. Significant points will be deducted for any over-flight of the spectator area and may be terminated.

6.3.1.3. Teams **shall** display their aircraft location and altitude in real-time with respect to the no-fly-zones and approved altitude limits -- **this is a prerequisite for any flight**.

6.3.1.3.1. Purely manual RC flights within the search area will only be allowed if aircraft location and altitude can be displayed on the mission map display with mission boundary no-fly-zones, under direct supervision of an AUVSI safety officer, and accurately displayed for judge's assessment.

6.3.1.4. After takeoff, the aircraft **shall** sustain flight at an altitude between 100 and 750 feet MSL for the duration of the mission.

6.3.1.4.1. Decent below 100 feet MSL (except during takeoff and landing in the recovery area) or above 750 feet MSL at any time **shall** require manual override. Failure of manual override will result in flight termination.

6.3.2. Takeoff

6.3.2.1. Takeoff **shall** take place within the designated takeoff/landing area, shown on the Competition Map (*Example*) of Appendix C, depending on wind direction.

6.3.2.2. Systems utilizing launchers and/or not performing a wheeled takeoff may utilize the grass immediately adjacent to the runway.

6.3.2.3.   Teams choosing to use the grass area must work with their assigned safety judge regarding launch direction. There may be safety restrictions that limit the direction a launcher can be faced.

6.3.2.4.   Takeoff from moving vehicles **shall** be prohibited.

6.3.2.5.   Takeoff under manual control with transition to autonomous flight will be permitted but does not count as an autonomous take off.

6.3.2.6.   The first takeoff will be scored, regardless if it is manual or autonomous. Only autonomous takeoff attempts on the first takeoff will earn points. Any other attempts at autonomous takeoff will be eligible for a prize.

6.3.3.   Landing

6.3.3.1.   Landing **shall** take place within the designated takeoff/landing area, shown on the Competition Map (*Example*) of Appendix C, depending on wind direction.

6.3.3.2.   All grass landings must be done within the takeoff/landing area, with a runway or taxiway between the aircraft and the student's and judge's tents on the flight line.

6.3.3.3.   Transition to manual control will be permitted for landing.

6.3.3.4.   Crashes and/or terminations will not be eligible to earn bonus points to shorten the mission clock.

7.   Description of Mission Tasks

The flight-mission demonstration has been divided into a series of primary and secondary tasks. Teams **shall ATTEMPT** all primary tasks first (except landing), prior to attempting any secondary tasks. The landing may occur after attempting any number of secondary tasks. The team **shall** meet the landing threshold in order to receive credit for any secondary tasks; failure to meet the primary landing parameter threshold will eliminate all secondary task scores.

The available tasks are listed in this section, whereas Section 8.0 provides the relative weighting of tasks.

7.1.   **AUTONOMOUS FLIGHT TASK (PRIMARY)**

Table 2: Autonomous Flight Parameters

Parameter	Threshold	Objective
Takeoff	Achieve controlled takeoff.	Achieve controlled autonomous takeoff.
Flight	Achieve controlled flight.	Achieve controlled autonomous flight.
Waypoint navigation (each waypoint)	Capture waypoint in sequence with ±50 ft. accuracy, and maintain navigation ±100 ft. along the planned flight path.	Capture waypoint in sequence while in autopilot control with ±50 ft. accuracy, and maintain navigation ±100 ft. along the planned flight path.
GCS display items	Accurately display "no-fly-zone boundaries" and **shall** accurately display current aircraft position with respect to the "no-fly-zone" boundary, display indicated airspeed (**KIAS**) and altitude (**feet-MSL**) to the operators and judges.	Specific requirements listed in Section 7.1.5.
Landing	Achieve controlled landing.	Achieve controlled autonomous landing.

7.1.1.   Takeoff

7.1.1.1.   A takeoff is considered autonomous if the aircraft is put into autopilot mode and the pilot does not command the vehicle during takeoff.

7.1.1.1.1.   The pilot or ground station operator may activate a button or switch to initiate the takeoff.

7.1.1.2.   A manually activated mechanical launcher with the aircraft in autopilot mode during the launch and climb-out maneuver will be a valid autonomous takeoff.

7.1.1.3.   A hand-launch with the aircraft in autopilot mode during the entire throw and climb-out is considered an autonomous takeoff.

7.1.1.4.   Control in takeoff will be subjectively graded for precision and safety.

7.1.1.5.   A team may elect to cycle through the takeoff and landing sequence more than one time, if necessary, for a variety of valid reasons (fix something, change batteries, etc.). **No points will be lost for landings and take-offs while on the mission clock.**

7.1.1.6.   The **first** takeoff is scored, regardless if it is manual or autonomous. Any other attempts at autonomous takeoff will be eligible for a prize.

7.1.2.   Flight

7.1.2.1.   The flight task evaluates the ability to safely sustain controlled flight.

7.1.2.2.   To receive autonomy points, the vehicle **shall** sustain controlled flight with no direct pilot input to flight controls or propulsion power.

7.1.2.3.   The sensor payload may be manually steered/controlled while flying under autonomous control (i.e. autopilot guidance), higher points of roughly one target at objective level are awarded if sensor payload is also under autonomous control.

7.1.3.   Waypoint Navigation

7.1.3.1.   All aircrafts **shall** overfly waypoints at the specified location and altitude to receive credit for waypoint capture.

7.1.3.2.   The aircraft **shall** not vary from the waypoint flight paths (± 100 ft).

7.1.3.3.   Each waypoint's specified location and altitude **shall** be achieved within an observed accuracy of ± 50 ft.

7.1.3.4.   The specified waypoint path will include changes in altitude.

7.1.3.5.   To achieve points for waypoints, they **shall** be captured in order. Waypoints captured out of sequence will not be scored.

7.1.4.   Landing

7.1.4.1.   A landing is considered autonomous if the aircraft remains under autopilot control during the approach, descent, touchdown, and rollout (if applicable) to a full-stop.

7.1.4.2.   A deep-stall landing is an acceptable autonomous landing provided the aircraft is in autopilot during the approach and the maneuver is scheduled, not initiated by an operator selection. (The intent is for the maneuver to be completed without a human input providing final guidance timing).

7.1.4.3.   The last landing is scored, regardless if it is manual or autonomous. Only autonomous landing attempts on the last landing will earn points. Any other attempts at autonomous landings will be eligible for a prize.

7.1.4.4.   Control in landing will be subjectively graded for precision and safety.

7.1.5.   Ground Station

7.1.5.1.   The system **shall** accurately display "no-fly-zone boundaries" and **shall** accurately display current aircraft position with respect to the "no-fly-zone" boundary, display indicated airspeed (**KIAS**) and altitude (**feet-MSL**) to the operators and judges. ***Failure to meet this requirement will result in disapproval to fly in the competition.***

7.1.5.1.1.   For rotary-winged aircraft, ground speed in knots **shall** be deemed acceptable.

7.1.5.2.   The system **shall** display waypoints with respect to the "no-fly-zone boundary" to the operators and judges.

7.2.   **SEARCH AREA TASK (PRIMARY)**

Table 3: Search Area Parameters

Parameter	Threshold	Objective
Localization (each standard and QRC target)	Determine target location within 150 ft. Must be paired with at least a threshold classification.	Determine target location within 75 ft. Must be paired with at least a threshold classification.
Classification (each standard target)	Identify any two target characteristics.	Identify all five target characteristics.
Classification (QRC target)	Detection.	Decode the message.
Imagery (each target)	n/a	Give judge a soft-copy of the target on USB drive.
Autonomous Search	n/a	Aircraft in autopilot control during search.
Secret message	n/a	Decipher the message anagram collected from the targets in the search area.

7.2.1.   Teams **shall** complete the waypoint navigation task in proper sequence and must pass through the last waypoint before entering the search area.

   7.2.1.1.   5 to 10 waypoints may be defined for this navigation task.

7.2.2.   Once transitioning into the search area, the vehicle **shall** search for specific targets of interest while staying within the no-fly-zone boundaries. Search area coordinates will be provided to teams during the check-in and orientation event. Targets will be distributed throughout the search area.

   7.2.2.1.   5 to 10 targets may be defined for this classification and imagery task.

7.2.3.   Images of the targets should be viewed by the judges when observed on the ground station display during the conduct of the mission.

7.2.4.   The UAS **shall** capture target images and identify target characteristics and locations for scores. The images **shall** be provided to the judges when handing in the target report sheet with the team's USB flash drive.

7.2.5.   Competitors **shall** record the target characteristics of all observed targets and provide this data to the judges on a target data sheet and/or in electronic form in the format given in Appendix D: Electronic Target Data Format and Appendix E: Target Score Sheet.

7.2.6.   Images **shall** be provided to the judges on the USB flash drive in JPEG format for proof during post-mission scoring.

7.2.7.   Area Search

   7.2.7.1.   The system should display search area boundaries to the operators and judges.

   7.2.7.2.   Aircraft **shall** search the area at any altitude as specified in section 6.3.1.4.

   7.2.7.3.   The targets will be located in the search area. The aircraft may fly outside the search area while searching for targets, but **shall** not fly outside the no-fly-zone boundary. There will be a minimum of 200 feet margin between the search area and the no-fly-zone boundary.

7.2.8.   Standard Targets

    7.2.8.1.   A number of standard targets will be constructed of plywood of a given size, basic geometric shape, and painted a color using flat paint. For an example, see Figures 1 and 3.
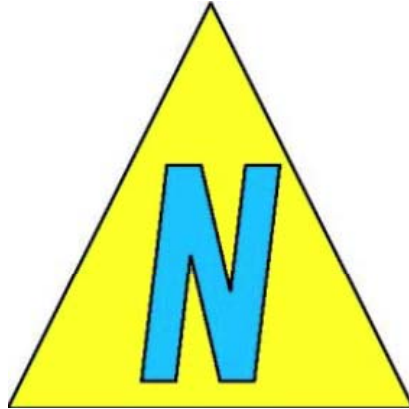

Figure 1: Example Target

    7.2.8.2.   The targets will be different geometric shapes (triangles, circles, etc.) and background colors; with a different color alphanumeric than the background color. The targets may be any mix of geometric shapes, letters and colors.

    7.2.8.3.   Target characteristics are:

        7.2.8.3.1.   Shape

        7.2.8.3.2.   Background color

        7.2.8.3.3.   Letter Orientation (N, NE, E, SE, S, SW, W, NW)

        7.2.8.3.4.   Alphanumeric (upper and lower case)

        7.2.8.3.5.   Alphanumeric color

        7.2.8.3.6.   Location (latitude, longitude)

    7.2.8.4.   The minimum dimension of the targets (length or width) will be two feet, and the maximum dimension will be 8 feet.

    7.2.8.5.   The alphanumeric will be sized to fit within the overall dimensions of the target varying between 50-90% of the length/width of the target and between 2-6 inches in thickness, and will vary in color and contrast.

7.2.9.   Quick Response Code (QRC) Target

    7.2.9.1.   One QR Code target will either be painted using flat paint or printed on weatherproof banner material and laminated onto plywood. For an example, see Figure 2.

    7.2.9.2.   The QR code will be generated using http://www.qr-code-generator.com/ using either URL or text options.

    7.2.9.3.   QR Code Target characteristics are:

        7.2.9.3.1.   QR Code size = 3 to 4 ft. square.

        7.2.9.3.2.   Minimum Pixel size = 1 in. square.

        7.2.9.3.3.   QR Code Color will be Black pixels, with White or Yellow background.

7.2.9.4. No Wi-Fi internet access will be provided at the flight-line, so teams shall display and provide the text encoded in the QR code. If the text is a URL, display and provide the URL as a text string.

7.2.9.5. In the example shown in Figure 2 the QR Code is for the URL of the English Wikipedia Mobile main page. The correct display and presentation of data would be; "*http://en.m.wikipedia.org*"

Figure 2: Example of a QR Code Target

7.2.10. Secret Message

7.2.10.1. Teams should arrange the alphanumeric of the targets to decode the "secret" message anagram, either using manual or automated methods. To get credit for this task parameter the anagram shall be submitted to the Judge before end of mission time.

7.2.10.2. In the example shown in Figure 3 the anagram is "FIREMAN".

Figure 3: Example Secret Message

7.3. **AUTOMATIC DETECTION, LOCALIZATION, AND CLASSIFICATION (ADLC) TASK (SECONDARY)**

Table 4: ADLC Parameters

Parameter	Threshold	Objective
Automatic Localization (each target, standard and QRC)	n/a	Identify target position within 150 ft.
Automatic Classification (each standard target)	n/a	Identify at least three of five target characteristics.
Automatic Classification (each QRC target)	n/a	Decode the message.
False Alarm Rate (FAR) on Classification	n/a	Demonstrate <50% FAR.

7.3.1. Teams **shall** develop an algorithm which performs automated detection of potential targets and cues the imagery judge. The algorithm **shall** localize the detected targets and automatically determine the target characteristics.

7.3.2. Credit will be given for each target automatically detected & cued, **up to six targets**.

7.3.3. ADLC may be performed by any combination of airborne or ground-based processing.

7.3.4. Teams **shall** make their ADLC process very clear to the imagery judge prior to aircraft takeoff.

7.3.4.1. If a judge is unclear about or suspects manual assistance to the ADLC process, the team **shall** not receive ADLC task points.

7.3.5. Demonstrating an ADLC target

7.3.5.1. ALL automatic detections **shall** be clearly shown to the imagery judge without human interaction (e.g. a pop-up window).

7.3.5.2. The **first six detections shown shall** be considered a team's entry for the ADLC task. These detections **shall** be turned into the judges by filling out a single dedicated target information sheet, given in Appendix E. This target information sheet **shall** be marked clearly with "Automatic Detections" and handed in separate from other imagery sheets. or provided electronically in accordance with Appendix D, and clearly marked in tab 11 as "Auto Detection

7.3.6. False Alarm Rate

7.3.6.1. If a listed target fails to meet the objective for classification, the target will be considered a false detection. The number of incorrect ADLC targets reported will be divided by the total number of ADLC targets reported to determine false alarm rate.

7.3.6.2. Each detection/target is counted once. If the false alarm rate exceeds the objective limit, no credit will be given for the ADLC task.

7.4. **ACTIONABLE INTELLIGENCE TASK (SECONDARY)**

Table 5: Actionable Intelligence Parameters

Parameter	Threshold	Objective
Actionable Intelligence (one standard target)	Identify target location within 150 ft. and 3 characteristics while airborne during the same flight.	Identify target location within 75 ft. and all 5 characteristics while airborne during the same flight.

7.4.1. The actionable intelligence task **shall** provide judges complete and accurate real-time information of one standard target identified during flight. Once the information is provided to the judges, it cannot be retracted at any time.

7.4.2. The standard target **shall** be one of those located within the same search area defined in the Search Area task.

7.4.3. Actionable Intelligence is only credited with correct identification of target characteristics (shape, background color, alphanumeric, alphanumeric color, and orientation) and sufficient location accuracy are provided while the aircraft is still in-flight, are recorded on the target data sheet, and are correct.

 7.4.3.1. *Target data downloaded from an aircraft while on the ground and then turned in when the aircraft is airborne again will not be scored.*

7.4.4. Credit for actionable intelligence will only be given for one standard target.

7.4.5. The team must turn in the Actionable Intelligence data sheet while the aircraft is airborne.

7.5.   **OFF-AXIS STANDARD TARGET TASK (SECONDARY)**

Table 6: Off-Axis Target Parameters

Parameter	Threshold	Objective
Imagery	n/a	Provide an image of the off-axis target on the USB flash drive
Classification	Identify any two target characteristics.	Identify all five target characteristics.
Payload Autonomy	n/a	Automatic persistent tracking of the off-axis target during search.

7.5.1.   Teams **shall** capture imagery of the off-axis standard target, which will have features the same as those described for targets in section 7.2, Search Area task.

7.5.2.   The off-axis standard alphanumeric target will be located outside the no-fly-zone.

7.5.2.1.   The coordinates for the off-axis target will be provided by the Lead Judge to the Team Captain at the start of mission time.

7.5.3.   Teams **shall** capture imagery of the off-axis target ***without crossing into the no-fly-zone boundary***. Teams are warned: do NOT enter the specified off-axis target location as a waypoint or the center of an orbit or YOU WILL FLY OUT OF BOUNDS and be penalized or required to terminate flight.

7.5.4.   The location of the off-axis target will be approximately 250 – 500 feet beyond the edge of the no-fly-zone. The system **shall** have the capability to capture imagery at an angle sufficient to detect and image the off-axis target without directly overflying it.

7.5.5.   Images of the off-axis target should be viewed by the judges when observed on the ground station display during the conduct of the mission.

7.5.6.   Competitors **shall** record the characteristics of the observed off-axis target and provide this data to the judges on a target data sheet and/or in electronic form in the format given in Appendix D: Electronic Target Data Format and Appendix E: Target Score Sheet.

7.5.7.   An image **shall** be provided to the judges on the USB flash drive in JPEG format for proof during post-mission scoring.

7.5.8.   The off-axis target **shall** be identified on the target score sheet or USB flash drive by providing the given coordinates for same.

7.6.   **EMERGENT TARGET TASK (SECONDARY)**

Table 7: Emergent Target Parameters

Parameter	Threshold	Objective
In-flight re-tasking	n/a	Add last known position of the emergent target as a waypoint.
Autonomous Search	n/a	Autopilot control during search.
Target Identification	Provide an image of the emergent target on the USB flash drive.	Provide an image of the target on the USB flash drive, target location within 75 ft, and an adequate description of the emergent target's activity.

7.6.1.   At the start of mission clock, the lead judge will give the Team Captain a new emergent search area (within the existing no-fly-zone boundaries). The UAS **shall** search within the emergent search area to locate the emergent target.

7.6.2.   At the time of vehicle takeoff, an updated waypoint for the last known position (LKP) of the emergent target will be given to the Team Captain. This new waypoint **shall** be uploaded to the aircraft in-flight to meet the in-flight re-tasking objective and will assist in the location of the emergent target.

7.6.3.   The UAS **shall** be under autopilot control during search for the emergent target.

7.6.4.   The emergent target will be in the form of a human engaged in an activity of interest, notably, a mannequin dressed up in some manner performing an activity. For example, see Figure 4.

Figure 4: The Emergent Target: Rescue Randy (Up Close and From Above)

7.6.5.   The UAS **shall** capture the emergent target in an image which **shall** be provided to the judges on the team's USB flash drive.

7.6.6.   Competitors **shall** record the characteristics of the observed emergent target and provide this data to the judges on a target data sheet and/or in electronic form in the format given in Appendix D: Electronic Target Data Format and Appendix E: Target Score Sheet.

7.6.7.   Images **shall** be provided to the judges on the USB flash drive in JPEG format for proof during post-mission scoring.

7.6.8.   The emergent target **shall** be imaged and described with enough detail to convince the judges of the target's activity.

7.6.8.1.   An inadequate description of the emergent target activity poorly describes the target and misses the activity (for example: "a man dressed in yellow.").

7.6.8.2.   An adequate description of the emergent target activity has enough detail to identify the specific activity (for example: "a fireman near a burning tree... he appears to be putting out the fire with a hose and extinguisher.").

7.7. **SIMULATED REMOTE INFORMATION CENTER (SRIC) TASK (SECONDARY)**

Table 8: SRIC Parameters

Parameter	Threshold	Objective
SRIC Download task	N/A	Download the SRIC message (the Login credentials for the Upload task).
SRIC Upload task	Upload a pre-canned image or text to the same folder.	Upload a current target picture verified by imagery judge to the same folder.
Autonomous SRIC task	N/A	Perform Download and/or Upload tasks while in controlled autonomous flight.

7.7.1. The aircraft **shall** carry an RF data communications payload capable of receiving data from and sending data to a third party Simulated Remote Information Center (SRIC). The airborne payload **shall** communicate with the team's ground station to enable logging into, downloading, and uploading text and images to the SRIC.

7.7.2. The SRIC has a directional antenna and will be located in the operational area. The aircraft **shall** be capable of remaining within the beam width at an altitude within the competition boundary and altitude restrictions for the duration of time it takes to communicate with the SRIC.

7.7.3. The SRIC IP address (and subnet mask) will be provided to teams at the Check-In and Orientation event.

7.7.4. Each team **shall** be provided a unique position of the SRIC, team folder and login information at the start of Set-up time before the Pre-Mission Brief.

7.7.5. The payload **shall** be capable of maintaining sufficient RF communication link with the SRIC (loitering, etc.) to use the team's private SRIC Download login credentials to access the SRIC folder and download the team's private SRIC Upload Login credentials for the upload task. Upon completion, the team **shall** provide a hard copy of the private SRIC Upload Login credentials to the judge to score points.

7.7.6. While the payload maintains sufficient RF communication link with the SRIC, the team **shall** use the private SRIC Upload Login credentials to upload an imagery file of a current target verified by the Imagery Judge to the same team SRIC folder to score points.

     7.7.6.1. The imagery file shall be provided in JPG format which should have compression quality of at least 90 and a minimum resolution of 720p (1280 × 720 pixels) to satisfy the Imagery Judge.

     7.7.6.2. If images are cropped and of lower resolution, the close cropped picture will be accepted if the team attempts to increase the resolution through other photo enhancement methods.

7.7.7. The team **shall** fly autonomously while performing the RF communication link with the SRIC during Download and Upload tasks.

7.7.8. For more information about the SRIC communications, see Appendix F: SRIC Details.

7.8.   **INFRARED (IR) TARGET TASK (SECONDARY)**

Table 10: Infrared Target Parameters

Parameter	Threshold	Objective
Classification	Identify the static target or symbol.	Identify both static and active targets symbols and orientation.
Autonomous Search	n/a	Autopilot control during search.
Image (each target)	n/a	Provide an image of the IR target on the USB flash drive.

7.8.1.   Teams **shall** demonstrate they have the capability to capture and locate the IR target using a mid-wave or long-wave thermal imaging devices. Team should understand using an EO camera with the IR filter removed may not adequately perform as expected.

7.8.2.   An Infrared (IR) target will be located within the search area previously defined in Search Area task. The coordinate position of the IR Target will be provided to teams at the Check-In and Orientation event.

7.8.3.   The UAS search for the IR target should be autonomous.

7.8.4.   Once transitioning into the predefined search area, the vehicle **shall** search for the IR target of interest while staying within the no-fly boundaries. Search area coordinates will be provided to teams during the check-in and orientation event.

7.8.5.   A primary IR target will be located within the search area. An alternate secondary IR target may be presented, also located within the search area.

7.8.6.   IR Target (Static)

   7.8.6.1.   The static IR target will be constructed of a rectangular plywood base between 2-4 feet in length and 2-4 feet in width. The plywood base will be painted so it blends into the background of the search area. The plywood will be angled at roughly 45 degrees from ground.

   7.8.6.2.   The target will contain a large 7-segment display using individual single IR emitters to form an alphanumeric symbol as illustrated in Figure 5.

   7.8.6.3.   These IR emitters operate in the mid-wave and long-wave region of IR (3 to 5 micrometers (µm) r wavelength, and up to 80 to 100 degrees Fahrenheit delta over ambient temperature.

7.8.7.   The static IR target characteristics to be recorded are limited to:

   7.8.7.1.   Orientation (N, NE, E, SE, S, SW, W, NW)

   7.8.7.2.   Alphanumeric or Symbol

Figure 5: Static IR Target Example

7.8.8.   IR Target (Active)

    7.8.8.1.   The active IR target will present an IR marquee script(s) and/or moving visual imagery target that may demonstrate a simple or complex image as a banner with text and symbols in motion across the target or a moving video image.

    7.8.8.2.   The IR target will be constructed of a rectangular frame between 1-4 feet in length and 1-4 feet in width. The base will be angled at roughly 45 degrees from ground.

    7.8.8.3.   The target will contain a display array using individual single multi-wavelength IR emitters to form images as illustrated in Figure 6.

    7.8.8.4.   The secondary IR emitter's temperature delta over ambient is dependent on the persistence of the marquee script(s) and/or moving visual imagery on the target These emitters operate in the short-wave Near-Infrared (NIR) region (0.8 to 1.5 µm wavelength) and mid-wave and long-wave region of IR. Since this target's best recognition/resolution for the marquee script(s) and moving visuals is in the NIR region, this target will likely be operated in the NIR region for this competition. Teams should be prepared if this target is operated in the IR regions.
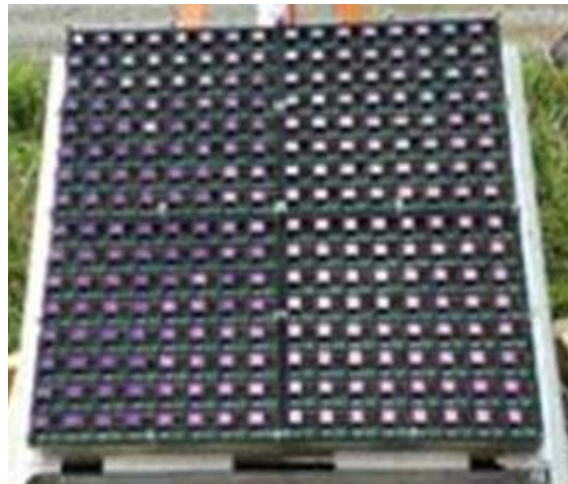

Figure 6: Active IR Target Example

    7.8.8.5.   The SUAS committee reserves the right to introduce, change or eliminate this active IR target before the flight-demonstration phase.

7.8.9.   The UAS **shall** capture the IR target images and identify target characteristics and location for scores. The images **shall** be provided to the judges either when observed on the ground station display during the conduct of the mission, or when handing in the target report sheet with the team's USB flash drive.

7.8.10.   Competitors **shall** record the target characteristics of all observed targets and provide this data to the judges on a target data sheet and/or in electronic form in the format given in Appendix D: Electronic Target Data Format and Appendix E: Target Score Sheet.

7.8.11.   Images should be provided to the judges on the USB- flash drive in JPEG format for proof during post-mission scoring.

7.9. **AIR-DROP TASK (SECONDARY)**

Table 11: Air-Drop Parameters

Parameter	Threshold	Objective
Release	Manual release within constraints.	Autonomous release within constraints.
Drop Accuracy	≤100 ft. from center.	≤30 ft. from center.
Bull's Eye Delivery	n/a	Hit the 5 ft radius bull's eye.

7.9.1. The air drop task is based on a UAS requirement to drop an emergency relief canister.

7.9.2. Teams **shall** demonstrate an air-drop using an air-drop canister.

7.9.3. An air-drop target will be located near the spectator area, within the operational area boundaries.

7.9.4. The GPS coordinates of the air-drop target will be provided to teams at the Check-In and Orientation event.

7.9.5. Each UAS team participating in the air-drop task **shall** only drop one (1) canister.

7.9.6. Release constraints

7.9.6.1. The air-drop canister **shall** be released into the airstream at an altitude between 350 ft. to 450 ft. MSL.

7.9.6.2. The UAS team may make multiple passes over the air-drop target, for example, to measure winds aloft or to visually identify the target for improving drop accuracy.

7.9.6.3. The UAS team **shall** approach the air-drop target parallel to the closest no-fly-zone boundary.

7.9.7. Target

7.9.7.1. The air-drop target will be a bulls-eye, with at least two concentric rings (threshold and objective) as shown in Figure 7.

7.9.7.1.1. Bulls-eye radius; X = 5 ft.

7.9.7.1.2. Objective radius; Y = 30 ft.

7.9.7.1.3. Threshold radius; Z = 100 ft.

7.9.7.2. Teams will be scored for successful air-drops within the target rings. Contact with the bulls-eye will be scored as a bonus.
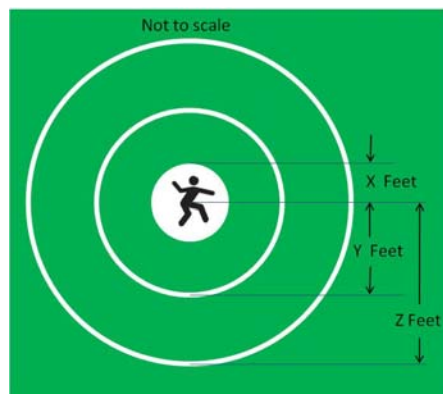

Figure 7: Air-Drop Target

7.9.8.   Air-Drop Canister

7.9.8.1.   Teams **shall** provide the air-drop canister, which **shall** be made from a single traditional plastic toy egg shell that separates into two halves.

7.9.8.2.   All canisters **shall** be filled with common material for ballast provided by the SUAS committee.

7.9.8.3.   The team **shall** fill the air-drop canister during Safety Inspections prior to being called to the flight line. A Judge will monitor the process of filling of the canister. The judge will measure the size and weight of the canister to ensure it meets the specifications, and once approved will seal the canister and impound the canister from the team. The canister will be returned to the team when it performs the pre-flight Safety Brief on the flight line.

7.9.8.4.   The Lead judge assigned to the team at the flight line will provide the Team Captain with the sealed canister once the set-up clock has started. The Safety judge will inspect and monitor the team loading the canister onto the aircraft prior to flight.

7.9.8.5.   The air-drop canister **shall** meet the specifications defined here and shown in Figure 8. Any variations to the canister design will result in disqualification to participate in the air-drop task.
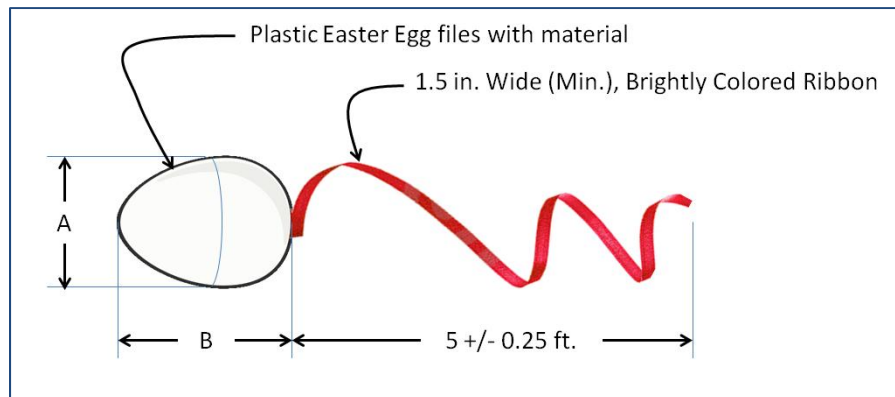

Plastic Easter Egg files with material

1.5 in. Wide (Min.), Brightly Colored Ribbon

A

B

5 +/- 0.25 ft.

Figure 8: Air-Drop Canister

7.9.8.6.   The air-drop canister's size **shall** not exceed 1.5 +/- 0.25 inches width by 2.0 +/- 0.5 inches length, not counting the ribbon. A Go/No-Go form-fit box will be used by the judges prior to flight to ensure the air-drop canister does not exceed the maximum dimensions.

7.9.8.7.   The air-drop canister **shall** use a drag ribbon. The ribbon **shall** be a minimum of 1.5 inches wide by 5 +/- 0.25 feet long. The ribbon **shall** be attached either internally or externally to the air-drop canister. The ribbon **shall** not be stiff; it must be "soft and limber fabric."

7.9.8.8.   The completed air-drop relief canister, with drag ribbon and ballast material fill, **shall** weigh a maximum of 4 oz.

7.9.8.9.   The drag ribbon **shall** successfully deploy its entire length before landing, and **shall** not separate from the canister.

7.9.8.10. The air-drop canister and drag ribbon **shall** be highly visible colors such as red or orange (not green!) to be easily identified in the grass and retrieved from the field to prevent Foreign Object Debris (FOD).

7.9.9. Release authority

7.9.9.1. There **shall** be a human in the loop to provide final air-drop release authority of the air-drop system, e.g. a human activated switch.

7.9.9.2. For an autonomous release, a human **shall** still be in the loop with full control: a human can hold a release approval switch/button for any duration of time, but the system **shall** go safe once the human rescinds the approval.

7.9.10. Release mechanism

7.9.10.1. No explosive, combustible, or corrosive materials **shall** be used in the construction of the air-drop task's release mechanism.

7.9.10.2. Compressed air release systems based on AMA rules may be used.

7.9.11. Release process

7.9.11.1. The Team Captain **shall** announce to the Safety Judge when the air-drop is imminent (30 seconds prior to manual release authority switch activation), when the release authority switch is engaged, and when the release authority switch is put back in safe mode.

7.9.11.2. The Safety Judge will echo these announcements via radio so participants and spectators can be given a heads-up.

7.9.11.3. If the air-drop canister releases unexpectedly, a safety penalty will be assessed.

7.9.12. Participation in the air-drop task **shall** only be allowed for those teams that provide demonstrated proof of prior safe and successful canister drops with documented results as briefed during the FRR presentation.

7.9.13. The team's air-drop task's release mechanism and air-drop canister **shall** pass safety inspection and the judge's risk assessment before being allowed to execute this task in the flight-mission demonstration phase of the competition.

7.10.   **INTEROPERABILITY TASK (SECONDARY)**

Table 9: Interoperability Parameters

Parameter	Threshold	Objective
Download & Display Server Time	Download & display at 1 Hz	Download & display at 10 Hz
Upload UAS Position	Upload position at 1 Hz	Upload position at 10 Hz
Download & Display Obstacles	Download & display at 1 Hz	Download & display at 10 Hz

7.10.1.   **NOTICE**: Due to administrative details still being worked on by the Seafarer Chapter, this task may have to be modified or removed from the rules before start of the competition. Updates and notices on this task will be provided to registered teams.

7.10.2.   **Purpose.** The interoperability task is based on the requirement for systems to integrate with each other using standard interface architectures. Interoperability enables systems to communicate critical information like aircraft position.

7.10.3.   An external system will be provided by the competition that implements a standard interface architecture. The UAS **should** integrate with this system. Such integration shall provide the teams with the server clock, provide judges with the UAS position, provide the UAS with positions of obstacles, and allow the judges to evaluate UAS performance.

7.10.4.   **Implementation.** The interoperability task is based on standard web communication. Teams should connect to the web server to both upload and download data via HTTP requests. All JSON formatted data and HTTP parameters will have a specific format that specifies the interface.

7.10.5.   **Network for Communication.** The UAS ground system should connect to the competition system using a provided Ethernet cable. This cable will be connected to a router configured with both DHCP and static IP addresses. A computer provided by the competition will also be connected to the router, and this computer will host the web server. The IP address and hostname of the web server **shall** be provided during the competition. More information can be found in Appendix G.

7.10.6.   **Inter-Computer Data Transport.** The team's ground system should make HTTP requests to the web server at the specified rate. URLs will be provided which specify the resource path for downloading and uploading data. Teams **shall** authenticate using standard web authentication in order to make requests. More information found can be found in Appendix G.

7.10.7.   **Service Interface.** The teams **shall** be provided with JSON format descriptions, relative URL paths, and HTTP parameter documentation. For testing prior to competition, the teams **shall** be provided with a sample web server that will implement the interface defined. This may or may not be the final server used at competition. More information can be found in Appendix G.

7.10.8.   **Deliverables.** Each interoperability component requires specific deliverables to verify satisfaction of the component. The competition judges will only evaluate the deliverables and will not evaluate the code or other indicators of interoperability. In order to receive credit, all deliverables **shall** be provided from before the first

takeoff until after the last landing, and teams must provide the deliverable at the rate specified. Failure to update at the specified rate will result in failing the task.

7.10.9. **Download, Upload, & Display Rates**. The goal rates for download, upload, and display are 1 Hz for the threshold and 10 Hz for the objective. A download, upload, or display rate that is on average below ½ Hz or at any time above 15 Hz will fail the threshold. A download, upload, or display rate that is on average below 8 Hz or at any time above 15 Hz will fail the objective. The rates will be computed during the flight clock. Teams **shall** begin downloading, uploading, and displaying from before the first takeoff and until after the last landing. The rates for each task parameter will be evaluated individually.

7.10.10. **Display Server Time**. The server time **shall** be displayed in real time at the autopilot operator station. This time will include the server wall clock time as well as other fields to verify correct integration. The server time and other fields will be updated on the competition server in real time.

7.10.11. **Report UAS Position**. The UAS position **shall** be uploaded to the competition server. The judges will have a system to evaluate whether the reported position corresponds to where the aircraft is actually located.

7.10.12. **Display Obstacles**. There are virtual obstacles for the Sense, Detect, and Avoid (SDA) task. The positions, sizes, and velocities of the obstacles should be downloadable from the interoperability server. This information **shall** be downloaded and displayed at the autopilot operator station. These obstacles **shall** be displayed in a view that also shows the UAS position, the mission boundaries, the task positions, and the UAS' waypoints. This view does not need to be the autopilot interface itself, but it **shall** be synced with any autopilot or mission changes.

7.10.13. **Mission Operation.** In the competition rules, teams are given the information necessary to build systems that integrate with standard interface architecture. The teams will receive additional information at competition, the day before flights, which will enable teams to configure their systems.

7.10.14. **Before Competition**. The standard interface architecture will be provided to teams as part of releasing the rules. This includes the format of the URLs, which indicate the relative paths but not the base path (hostname and port), the various HTTP parameters, and the format of the JSON data. During the year before competition, updates may be applied to the interoperability server and synced with the code repository. Teams **shall** download and sync updates through the code repository.

7.10.15. **Day Before Mission Demonstration (Flights)**. Teams will be given the static IP address, the hostname, and the port of the web server, which together comprise the base path of the request URLs.

7.10.16. **Mission Setup Time**. Teams will be able to physically connect Ethernet cables to their UAS ground station. The Ethernet cord may or may not be connected to the router. Regardless of whether the cord is connected or not, the web server will ignore requests and return appropriate error codes. Teams will also be given authentication credentials. Teams must not share these credentials.

7.10.17. **Mission Flight Time**. At the start of the mission the judge server will be reconfigured to accept and respond to requests from the UAS system. If the Ethernet cord was not connected, it will be connected and allow teams to

communicate. Teams **shall** then start downloading and displaying the server clock, downloading and displaying the obstacles, and uploading the UAS position. The teams **shall** continue downloading and uploading for the remainder of the mission flight time.

7.11. **SENSE, DETECT AND AVOID (SDA) TASK (SECONDARY)**

Table 12: SDA Avoid Parameters

Parameter	Threshold	Objective
Stationary Obstacle Avoidance	Avoid collision with the stationary virtual obstacle(s).	Automatically adjust flight path to avoid obstacle(s)
Moving Obstacle Avoidance	Avoid collision with the moving virtual obstacle(s).	Automatically adjust flight path to avoid obstacle(s)

7.11.1. **NOTICE**: Due to administrative details still being worked on by the Seafarer Chapter, this task may have to be modified or removed from the rules before start of the competition. Updates and notices on this task will be provided to registered teams.

7.11.2. **Prerequisites.** The UAS needs the obstacle positions in order to be able to avoid the obstacles, and the judges need the UAS position to evaluate proximity to virtual targets.

7.11.2.1. In order to be eligible for the SDA task, the UAS **shall** accomplish all objectives for the Interoperability task. This includes all interoperability tasks: server clock, UAS position reporting, and obstacle display.

7.11.2.2. The interoperability implementation **shall** download, upload, and display at the goal rate while near obstacles. If data dropouts, reduced update rates, or other such problems make it difficult to evaluate obstacle avoidance, then the team will fail the SDA task.

7.11.3. **Purpose.** The Sense, Detect, and Avoid (SDA) task is based on the National Airspace (NAS) requirement that a UAS must operate under standard aviation See and Avoid rules of engagement when operating in proximity of other aircraft.

7.11.4. This task is designed to gradually develop towards full SDA capabilities. For this competition, the obstacles will be virtual and the task of sensing and detecting obstacles will be simulated through the interoperability task. The goal is to develop UAS obstacle avoidance capabilities. In future years the competition may be expanded to include sensing and detecting real obstacles.

7.11.5. **Obstacles.** The UAS has collided with an obstacle if the UAS position (GPS and altitude) is contained within the obstacle. Collision with an obstacle fails the task threshold. The stationary and moving obstacle tasks are evaluated independently.

7.11.6. The JSON data, which contains obstacle positions, will contain 0, 1, or many obstacles. The UAS should not make any assumptions about the number or the type of obstacles.

7.11.7. Stationary Obstacles.

7.11.7.1. Defined as cylinders with a given radius, height, and GPS position.

7.11.7.2. The height axis is aligned perpendicular to ground, and the radius axis parallel to ground. The lower circular cap to the cylinder will be at ground and parallel with it. The height gives the altitude of the upper circular cap of the cylinder.

7.11.7.3. The GPS position reported will be that of the cylinder's centroid.

7.11.7.4. Stationary obstacle will be between 30 feet and 300 feet in radius, and will have heights between 0 feet and 750 feet.

7.11.8.   Moving Obstacles.

      7.11.8.1.   Defined as spheres with a given radius, GPS position, and altitude.

      7.11.8.2.   The GPS position reported will be that of the sphere's centroid.

      7.11.8.3.   The path that moving obstacles will follow will be a smooth continuous path, but reported obstacle positions will be sampled at 10 Hz. The moving obstacles will follow a predetermined path and will not react to external influences like the UAS. The path may or may not be a loop. The speed may change over the course of the mission.

      7.11.8.4.   Moving obstacles will be between 30 feet and 200 feet in radius, and will move at a speed between 0 KIAS and 40 KIAS.

7.11.9.   **Obstacle Avoidance.** The stationary and moving obstacle avoidance tasks are evaluated independently. For example, the UAS can achieve the objective for one of the tasks and fail to receive the threshold for the other.

      7.11.9.1.   To achieve threshold obstacle avoidance, the system **shall** perform the entire mission without colliding with an obstacle.

      7.11.9.2.   To achieve objective obstacle avoidance the system **shall** autonomously, without human input, update the flight plan to avoid the obstacle. Flight plans that are manually generated before the mission and happen to avoid the obstacles will not constitute a failure to automatically avoid. Similarly, changing the flight plan to adjust for the emergent target or to adjust for the in-flight re-tasking task will not constitute a failure to automatically avoid. Manual flight plan adjustments that appear to be in reaction to obstacles will constitute a failure to automatically avoid. The judges have sole discretion to judge whether human input violates the automatic avoidance objective.

8.   Scoring Metrics for Graded Elements

8.1.   **RELATIVE WEIGHTING**

8.1.1.   The Seafarer Chapter does not specify rubric or point values associated with scoring for each task of this competition. However, the relative weighting of the various sections is specified so teams can determine how to focus their efforts.

8.1.2.   The major graded elements and their weighting are:

8.1.2.1.   25%   Journal Paper

8.1.2.2.   25%   FRR Oral Presentation

8.1.2.3.   50%   Flight-Mission Demonstration

8.1.3.   For each phase of the competition and each mission task, special scoring emphasis will be separately assessed for communication in journal papers and oral presentation, format in journal papers, and systems engineering, mission performance, autonomy, and safety during the tasks in the flight-mission phase.

8.1.4.   Safety is integral to the continuation of unmanned flight in controlled airspace and future extension into un-controlled airspace. As such, safety will be graded in all phases of the competition, to include operational, design and programmatic risks and safety considerations. Safety will be weighted 10% of each graded element.

8.1.5.   Additionally penalties will be assessed for exceeding no fly zone and altitude limits, judge directed flight termination, "Things Falling off Aircraft" and Crashes.

8.2.   **NORMALIZATION PROCESS**

8.2.1.   A normalization process is used for both the journal paper and the FRR briefings in order to equalize individual judges or groups in teams of judges.

8.2.2.   For the journal paper, one team's paper is selected for all the judges to read to establish a normalization factor for all individual judges' scores for other papers.

8.2.3.   For the oral presentation, one team is selected to present their FRR briefing to all the judges at the same time, but scored as separate judging teams, to establish a normalization factor for each judging team.

8.2.4.   The flight-mission demonstration element is not normalized.

8.3.   **JOURNAL PAPER**

8.3.1.   The journal paper **shall** include the following sections:

8.3.1.1.   Title page with abstract

8.3.1.2.   Description of the systems engineering approach

8.3.1.2.1.   Mission requirements analysis (what tasks are planned)

8.3.1.2.2.   Design rationale

8.3.1.2.3.   Expected task performance

8.3.1.2.4.   Programmatic risks and mitigation methods

8.3.1.3.   Descriptions of the UAS design

8.3.1.3.1.   Design descriptions of the aircraft, autopilot system, data link, payloads, ground control station, data processing, and mission planning

8.3.1.3.2.   Target types for autonomous detection (if utilized)

8.3.1.3.3.   The paper **shall** include a photo of the UAS aircraft

8.3.1.4.   Test and evaluation results

     8.3.1.4.1.   Mission task performance

     8.3.1.4.2.   Payload system performance

     8.3.1.4.3.   Autopilot system performance

     8.3.1.4.4.   Evaluation results supporting evidence of likely mission accomplishment.

8.3.1.5.   Safety considerations/approach

     8.3.1.5.1.   Specific safety criteria for both operations and design

     8.3.1.5.2.   Safety risks and mitigation methods

8.3.2.   Writing style will be scored for clarity, accuracy, logic, precision, relevance, depth and suitability.

8.3.3.   The electronic journal paper **shall** be prepared so that if an evaluator prints the document, it meets the following format requirements:

     8.3.3.1.   8.5 x 11 inch paper

     8.3.3.2.   Single-spaced typed lines

     8.3.3.3.   Not less than 1 inch margins

     8.3.3.4.   Not smaller than 10-point Times New Roman font in text

     8.3.3.5.   Each page **shall** have the school and team name, and page number, in the footer.

     8.3.3.6.   No more than 20 pages total. Pages beyond 20 pages will not be graded (*judges are instructed to only print pages 1-20).

8.3.4.   Journal papers **shall** be electronically submitted in PDF format.

8.3.5.   Journal paper's filenames **shall** include the school and team name, abbreviated as needed, and have the pre-fix "JP" (capital letters "JP" will identify the file as the journal paper, which must be different from the fact sheet filename)

8.3.6.   Upload the journal papers to the team's unique folder on the SUAS SharePoint site, per Section 10.1.4

8.3.7.   To give teams the ability to optimize their allocation of resources for the journal, the **approximate** relative worth of each area of the presentation is given:

     8.3.7.1.   System Engineering-10%

     8.3.7.2.   Design Description-30%

     8.3.7.3.   Test and Evaluation Results-25%

     8.3.7.4.   Safety Considerations-10%

     8.3.7.5.   Writing Style-20%

     8.3.7.6.   Format-5%

8.4.   **FRR Briefing & Static Display**

8.4.1.   The FRR briefing will be assessed on the team's ability to effectively articulate the scope and depth of the developmental testing performed, the ability of the system design to perform the planned flight tasks, and the preparations made to improve the chances of a successful Flight-Mission Phase.

8.4.2.   A static display **shall** be used to assist in communication during the briefing. The static display **shall** include visual aids and the actual system being demonstrated, to support and clarify the team's briefing.

8.4.3. The FRR briefing **shall** not exceed 15 minutes in duration, followed by a maximum period of 5 minutes where the judges will ask questions and the team **shall** answer. Afterwards, another period of roughly 5 minutes is allocated for judges to review and inspect the static display. A judge will time the presentation, provide a 2 minute warning, and cut off extended presentations as needed.

8.4.4. The breadth of the presentation will be scored based upon inclusion of the following elements:

8.4.4.1. Team member introductions including flight mission demonstration roles and experience.

8.4.4.2. A brief system overview relating to the flight tasks planned, expected performance, and any programmatic risks.

8.4.4.3. System Safety with identified design and operational, avoidance, and mitigation strategies.

8.4.4.4. Developmental Test Results including: the scope of test planning from simulation and analysis, through laboratory and ground testing, to flight testing; the conduct of system integration from component/subsystem testing, through Air Vehicle, Ground Control Station and full system testing, to mission performance testing; efforts to acquire test data and evaluate performance, the results of flight testing including an assessment of their sufficiency, any corrective action taken and the impact on the mission design.

8.4.4.5. Evidence of Mission Accomplishments, to include evidence that the system is sufficiently mature, defined and representative to accomplish the planned test objectives and/or support defined program objections; verification of all traceable design requirements, identification of defined flight/system limitations and justification of readiness to proceed to the Mission Phase

8.4.4.6. Pre-Mission Briefing, including proper resourcing for the flight (people, test article or articles, facilities, data systems, support equipment, logistics, etc.) and crew member training; final, standard and anomalous condition reporting procedures; Go/No-Go criteria and fallback plans should a technical issue or potential showstopper arise during flight-mission demonstration.

8.4.4.7. Static Display including display materials, air vehicle and ground control station, relevant equipment (antennas, safety equipment, etc.), and supporting documentation (test data, safety checklists, and other supporting evidence). A PowerPoint slide display alone is not adequate.

8.4.4.8. Team member participation.

8.4.5. The content of the presentation will be assessed in general based upon the team's communication skills and specifically as indicated for the following areas:

8.4.5.1. Question and Answer session to include knowledge of the system, mission performance, testing scope and methods, results and risks.

8.4.5.2. Craftsmanship of the air vehicle and ground control station will be assessed during the static display element.

8.4.5.3.   Identification the risk level is acceptable and judgment that previous component, subsystem, and system test results form a satisfactory basis for proceeding into flight-mission demonstration

8.4.6.   In the interests of expediency, oral reference to relevant briefing information that is visible on the static display materials will be considered in scoring the breadth of the presentation, but may not be sufficient to receive full credit alone.

8.4.7.   Communication skills will be scored for clarity, accuracy, logic, precision, relevance, depth and suitability. International students will not be downgraded for difficulties with spoken English as long as the intent of the speech is understood.

8.4.8.   To give teams the ability to optimize their allocation of time within the FRR, the approximate relative worth of each area of the presentation is given:

8.4.8.1.   System Description-5%

8.4.8.2.   System Safety Overview-5%

8.4.8.3.   Developmental Test Results

         8.4.8.3.1.   Test Planning & Execution-20%

         8.4.8.3.2.   Test Results-10%

8.4.8.4.   Evidence of Mission Accomplishment-10%

8.4.8.5.   Pre-Mission Brief-10%

8.4.8.6.   Question and Answer-5%

8.4.8.7.   Static Display-15%

8.4.8.8.   Communication Skills-20%

8.4.9.   Portions of the presentation exceeding the specified time limits (see section 4.14) will not be considered for score.

8.5.   **FLIGHT-MISSION DEMONSTRATION**

8.5.1.   The mission is split into several independent tasks with each task having graded parameters that highlight certain capabilities of the competitor's system. Emphasis has been placed on ensuring these tasks are clearly gradable.

8.5.2.   Teams may choose to complete any number of tasks. The more tasks that can be completed increases the total number of points a team earns, but beware that exceeding mission time will result in a loss of points.

8.5.3.   It is the SUAS committee's intent to supply more tasks than can be completed in the available mission time. The teams should perform trade-studies (hint: use the relative worth of tasks) to assess their mission objectives and design approach.

8.5.4.   Task priority weighting tiers are specified as either <u>primary</u> or <u>secondary</u>.

8.5.4.1.   <u>Primary</u> tasks are intended to be the core mission focus, and **shall** be attempted first before scoring any points on secondary tasks.

8.5.4.2.   <u>Secondary</u> tasks are intended to be stretch objectives, and as such will be scored with less weighting than primary tasks.

8.5.4.3.   The weightings of task priorities are:

         8.5.4.3.1.   60%   Primary

         8.5.4.3.2.   40%   Secondary

8.5.5.   Parameters in the same task are scored equally.

8.5.6. Each mission task parameter is split into three completion levels: incomplete, threshold, and objective. These completion levels denote weighting tiers. See the description of each task in Section 7.0 for details about the completion level for an individual task parameter.

  8.5.6.1. Incomplete specifies that a team did not achieve the threshold criteria.

  8.5.6.2. Threshold specifies the minimally acceptable completion criteria, and is scored at a loss relative to the objective level.

  8.5.6.3. Objective specifies the desired completion criteria for maximum points.

  8.5.6.4. The weightings of completion levels are:

    8.5.6.4.1. 0% Incomplete

    8.5.6.4.2. 50% Threshold

    8.5.6.4.3. 100% Objective

8.5.7. To give teams the ability to perform a trade study in their systems engineering design process, the relative worth of each task in its priority tier are given:

  8.5.7.1. Primary

    8.5.7.1.1. Autonomous flight – 50%

    8.5.7.1.2. Search area – 50%

  8.5.7.2. Secondary

    8.5.7.2.1. ADLC – 20%

    8.5.7.2.2. Actionable Intelligence – 10%

    8.5.7.2.3. Off-axis – 10%

    8.5.7.2.4. Emergent Target – 10%

    8.5.7.2.5. SRIC – 10%

    8.5.7.2.6. IR Targets – 10%

    8.5.7.2.7. Air Drop – 5%

    8.5.7.2.8. Interoperability – 5%

    8.5.7.2.9. Sense, Detect and Avoid – 20%

8.6. **JUDGES**

8.6.1. The judges for the competition are volunteers from across industry and the government, and there may be uniformed service members acting as judges. Many of the judges have extensive UAS experience.

8.6.2. Many judges help grade journal papers as well as the FRR briefs and flight-mission demonstrations. However, do not assume that every judge has read your journal paper and is familiar with your system. Judges involved with the oral briefing are required to stay involved through all oral briefings. Judging teams for the flight-mission demonstration are required to stay with a team while that team is on the mission clock.

9.   Safety Regulations

9.1.   FLIGHT OPERATIONS

9.1.1.   Flight operations of any type involve some level of risk to personnel and property. It is the responsibility of all personnel involved in and around flight operations to identify, evaluate and mitigate risks to the maximum extent possible. Systems that do not meet the requirements listed below will not be permitted to fly.

9.2.   LIABILITY

9.2.1.   Seafarer Chapter of AUVSI and the host organization, their employees and agents, as well as the SUAS committee, are in no way liable for any injury or damage caused by any entry, or by the disqualification of an entry.

9.2.2.   Each member of participating teams **shall** sign and submit a waiver holding Seafarer Chapter of AUVSI and the host organization harmless of any accident claims. The form, described in Appendix H, **shall** be turned in during the Check-in and Orientation process.

9.3.   AIRCRAFT

9.3.1.   Aircraft **shall** comply with the 2014 Official Academy of Model Aeronautics (AMA) National Model Aircraft Safety Code, (http://www.modelaircraft.org/files/105.pdf) except as noted below:

9.3.1.1.   Autonomous operation is authorized.

9.3.1.2.   GENERAL – all rules apply; 2(f) replaced by team name, not AMA team name.

9.3.1.3.   RADIO CONTROL – all rules apply.

9.3.1.4.   FREE FLIGHT – not applicable.

9.3.1.5.   CONTROL LINE – not applicable.

9.3.2.   The maximum takeoff gross weight of the aircraft **shall** be less than 55 lbs. when fueled and weighed with a calibrated scale during SUAS competition inspections.

9.3.3.   The maximum airspeed of the aircraft **shall** not exceed 100 KIAS.

9.3.4.   The system **shall** provide sufficient information to the judges on a continuous basis to ensure that it is operating within the no-fly/altitude boundaries.

9.3.5.   The aircraft **shall** be capable of manual override by the safety pilot during any phase of flight.

9.3.6.   Flight Termination

9.3.6.1.   The flight termination system **shall** be capable of activation by the safety pilot or pilot in command.

9.3.6.2.   A return home or return to land (RTL) system, if installed, **shall** be capable of activation by the safety pilot.

9.3.6.3.   The aircraft **shall** automatically return home (takeoff location) after loss of primary communications link signal of more than 30 seconds.

9.3.6.4.   The aircraft **shall** automatically terminate flight after loss of primary communications link of more than 3 minutes.

9.3.6.4.1.   If the aircraft flight termination system is independent of the primary communications link then the aircraft

may continue with an autonomous return to home or RTL routine if installed.

9.3.6.5. Flight termination for fixed wing aircraft without an alternate recovery system (like a parachute) **shall** select:

9.3.6.5.1. Throttle closed

9.3.6.5.2. Full up elevator

9.3.6.5.3. Full right rudder

9.3.6.5.4. Full right (or left) aileron

9.3.6.5.5. Full flaps down (if so equipped)

9.3.6.5.6. For other than fixed-wing aircrafts, similar safety requirements will be assessed which result in a power off recovery in minimum energy manner at a spot on the ground no more than 500 ft radius over the ground from the point of the termination command.

9.3.6.6. The fail-safe check will demonstrate flight termination on the ground by switching off the transmit radio for 30 seconds or 3 minutes (whichever applies) and observing activation of flight terminate commands.

9.3.6.6.1. Questions regarding conduct of the safety check may be sent to the SUAS Competition Director detailed in Section 10.1.8

9.3.7. Exotic, unusual fuels/batteries or components **shall** not be used. Any fuel/battery combination deemed high risk in the opinion of judges will be disqualified.

9.3.8. All batteries used in the aircraft **shall** be colored brightly to facilitate locating them in the event of a crash. Wrapping batteries in bright colored tape is preferred.

9.3.9. At least 25% of the upper, lower and each side surface of the vehicle **shall** be a bright color (white, yellow, etc.) to facilitate visibility in the air and in the event of a crash.

9.4. **GROUND CONTROL SYSTEM**

9.4.1. The ground control system, being a local repository on the flight line of all aspects of the overall system except the aircraft, should include adequate safety materials for personnel protective equipment (PPE) (tools, gloves, eye protection, hearing protection, etc.), safety risk mitigation (training, check lists, etc.) and equipment to support rapid response to accidents (first aid kit, fire extinguisher, etc.) as needed.

9.4.2. All ground vehicles **shall** be off the runway area and parked in the grass.

9.5. **SAFETY INSPECTIONS**

9.5.1. All aircraft **shall** undergo a safety inspection by designated competition safety inspectors prior to being allowed to make any competition or non-competition (i.e., practice) flight.

9.5.2. All decisions of the safety inspector(s) **shall** be final.

9.5.3. Questions regarding conduct of the safety inspection may be sent to the SUAS Safety Inspector contact detailed in Section 10.1.8.

9.5.4. Safety inspections **shall** include a physical inspection, fail-safe check, flight termination check, and a maximum weight check.

9.5.5. Physical inspection of aircraft **shall** include:

9.5.5.1. Verify all components adequately secured to vehicle.

9.5.5.2. Verify all fasteners tight and have either safety wire, locktite (fluid) or nylock nuts.

9.5.5.3. Verify propeller/rotor structural and attachment integrity.

9.5.5.4. Visual inspection of all electronic wiring to assure adequate wire gauges and connectors in use. Teams **shall** notify safety inspector of expected maximum current draw for the propulsion system, if electric.

9.5.5.5. Radio range checks, motor off and motor on.

9.5.5.6. Verify all controls move in the proper sense.

9.5.5.7. Check general integrity of the payload system.

9.5.5.8. Verification of fail-safe mode operation covered by manual override and pilot-commanded flight termination.

9.6. LAUNCHERS

9.6.1. Takeoff **shall** not be allowed from moving vehicles.

9.6.2. Launchers **shall** be inspected by competition safety inspectors before they are allowed for use in the competition.

9.7. OTHER

9.7.1. No more than ten team members (including one advisor and one safety pilot) will be allowed in the mission area (total of 10 people, per section 10.8.5).

9.7.2. Location of aircrafts for take-off must be past the centerline, away from the tents, and the direction of flight during taking off and landing should avoid using the runway near the team and judging flight line area.

9.7.3. No objects **shall** depart from the aircraft while in flight (except during intentional execution of the air-drop task).

9.7.4. Any team's hardware, software, or personnel that, in the opinions of the competition officials or the representatives of the host facilities, pose an unreasonable safety hazard to personnel or property, or risk to the integrity of the host facility, will be disqualified and not be allowed to operate.

9.7.5. Officials will have the right to disqualify any entry that they deem a hazard.

9.7.6. No Foreign Object Debris (FOD) recover teams **shall** be on the active field/runway when another aircraft is preparing to launch or in the air unless coordinated and approved by the Competition Director or Safety Judge.

9.7.7. Open toed shoes/flip flops should not be worn during safety inspections, flight line operations, or when aircraft engines are powered (even in the pit area).

9.7.8. If anyone observes anyone in an unsafe activity or an imminently unsafe activity, say something! Safety is a shared responsibility.

9.7.9. Judges may deduct points as penalty for procedural safety errors (even accidental), not related directly to flight mission, such as improper safety practice in the pit area.

9.7.10. The decision on a safety call by the On-Field Safety Officer will be final.

10. Competition Clauses

10.1. OFFICIAL INFORMATION SOURCE

10.1.1. If a team experiences technical difficulties with electronic submissions, they must contact the SUAS Committee prior to the relevant submission deadline.

10.1.2. All submittals will be electronic via the team's folder on the SUAS competition SharePoint site, except the initial registration application and registration fee.

10.1.3. The SUAS Competition internet URL:

10.1.3.1. http://www.auvsi-seafarer.org

10.1.4. The SUAS Competition SharePoint login URL:

10.1.4.1. https://docs.goctsi.com/sites/SUAS

10.1.4.2. Specific team usernames and passwords will be provided by the Competition Director after registrations have been accepted.

10.1.5. The SUAS Competition e-mail addresses (***use all e-mails for each correspondence***):

10.1.5.1. tim.piester@urs.com; wayne.devereux@wyle.com; mark.r.pilling@saic.com; elledge_kerstin@bah.com

10.1.5.2. Subject line: "2015 SUAS" and "school or team name" "- subject".

10.1.6. **AUVSI Seafarer Chapter** and **SUAS Competition mailing address (FEDEX and UPS do NOT ship to Post Office Box):**

AUVSI Seafarer Chapter
Post Office (P.O.) Box 141
California, MD 20619
ATTN: Chapter President

10.1.7. **SUAS University Day** conference phone call number and Webex meeting URL:

10.1.7.1. Choose one of the following numbers to dial:

If teams call in from an office location with on-site number(s) (listed below), try this number first. If you do not have on-site access, or you are not a member of the host's company/organization, use one of the other numbers shown.

* Toll-Free Number (in USA): 888-369-1427
* Caller-Paid number: 602-333-2024
* Blackberry (Toll-Free Number): 8883691427x2303854#
* When prompted, enter the Meeting Access Code: 2303854#

A number in your country or in a country close to you (may be toll free):

https://www.teleconference.att.com/servlet/glbAccess?process=1&accessNumber=8883691427&accessCode=2303854

10.1.7.2. To connect to the Web Conference use URL:

https://connect15.uc.att.com/urs/meet/?ExEventID=82303854

10.1.7.3. If teams are interested, the SUAS committee can forward the Webex meeting maker if the schools provide an e-mail address.

10.1.8. SUAS Competition primary point of contacts:

Seafarer Chapter President – Tim Piester
Competition Director – Mark Pilling
Head Judge – Wayne Devereux
Safety Inspector – Rob Ross

10.1.9.   **SUAS Check-in and Orientation** location address:

Patuxent River Naval Air Museum

22156 Three Notch Rd, Lexington Park, MD 20653

Phone: 301-863-7418

Website: http://paxmuseum.com/

10.1.10. **SUAS Competition location** (for oral presentation and flight-mission demonstration) address:

Naval Air Station Patuxent River

Webster Outlying Field

St. Inigoes, MD 20684

Website: http://www.wiki.somd.com/index.php/Webster_Field

10.1.11. **SUAS Awards Banquet** location and address:

Hollywood Volunteer Fire Department (HVFD) Social Hall

24801 Three Notch Rd

Hollywood, MD 20636

Phone: 301-373-3910

Website: http://www.hvfd7.com/content/hall/

10.2.   **OFFICIAL PARTICIPATION**

10.2.1.   All e-mails, written submissions, oral presentations, and discussions **shall** be in English.

10.2.2.   All applications, forms, technical journals, photos, etc. provided either as an e-mail attachment or uploaded to the official SharePoint site, **shall** be submitted in PDF format.

10.2.3.   All official payments **shall** be made in U.S. dollars (USD).

10.2.4.   Registration payment **shall** be only as Check or Money Order. No electronic transfer or credit card payments will be accepted.

10.2.5.   The team's registration is not considered officially received until the properly completed application form and the full amount of entry fee have been received by AUVSI Seafarer Chapter, in accordance with the requirements of Section 10 and before the deadline listed in the Schedule table in Section 3.

10.3.   **OFFICIAL REGISTRATION APPLICATION**

10.3.1.   Each team must complete the Application Form on the Seafarer Chapter using typed characters, as no hand-written applications will be accepted. No other form of application will be accepted.

10.3.1.1.   Teams must provide primary financial and technical contacts with detailed addresses to ensure registration and payment questions, reimbursements, and prize money payments can be properly accounted for and tracked.

10.3.2.   Deadline for the registration application form and payment is listed in the Schedule table in Section 3.

10.3.3.   Teams will receive an acknowledgement of receipt of registration application and payment from the SUAS committee. If applications are incomplete, payment will not be processed and may be returned with a failure to meet registration notice.

10.3.4.   Teams who fail to properly meet the application requirements will be informed by the Competition Director or Treasure of the AUVSI Seafarer's Chapter within two weeks after the deadline listed in the Schedule table in Section 3.

10.3.5.   Due to the large number of teams interested in competing, the SUAS committee reserves the right to limit the total number of entries that are allowed to compete by declaring the competition closed to new entries at any time.

   10.3.5.1.   As with all official information, this announcement (should it be necessary) will appear on the official information source website.

10.4. OFFICIAL REGISTRATION FEE

10.4.1.   The 2015 SUAS Competition registration fee is $750.00 USD.

   10.4.1.1.   Teams outside of the United States must mail checks or money orders.

10.4.2.   Payment **shall** be made to: "AUVSI Seafarer Chapter".

10.4.3.   All official payment of registration fees must be by Check or Money Order only. NO Electronic Funds Deposit or credit card payments **shall** be accepted.

10.4.4.   Payments for registration fee must be mailed to the AUVSI Seafarer Chapter at the address listed in Section 10.1.6.

10.4.5.   Deadline for the registration fee is listed in the Schedule table in Section 3.

10.4.6.   Registration application and registration fee payment must BOTH be posted no later than the deadline date and time in the competition Schedule to be registered.

10.4.7.   If a team does not meet the registration process requirements, the registration fee will be reimbursed.

10.4.8.   No credits to future competitions **shall** be granted.

10.4.9.   Each application **shall** include both team Advisor and Captain contact information.

10.5. WITHDRAWAL PROCESS

10.5.1.   If a team decides to withdraw from the competition, the Team Captain must formally submit a written request to withdraw to the SUAS Committee.

10.5.2.   The request to withdraw may be by e-mail or by posting a written document titled "Withdrawal" in the team's SharePoint, as defined in Section 10.1.

10.5.3.   The deadline a team may withdraw from the SUAS competition and still receive a reimbursement of the registration fee is detailed in the schedule of Section 3.

10.5.4.   Failure to properly withdraw from the competition by the deadline **shall** result in forfeiture of the registration fee.

10.5.5.   Reimbursement checks will be made out to the person or organization listed on the registration application to receive the reimbursed money, unless the withdrawal notification indicates a different person or organization.

10.5.6.   No credits to future competitions **shall** be granted.

10.6. DOWN-SELECTION

10.6.1.   The SUAS committee may implement a down-selection process to restrict the number of teams from participating in any one or all phases of the competition.

10.6.2.   The initial form of down-selection is accomplished on a first-come-first-served basis. Therefore, late submission of a team's application form and/or registration fee will result in that team's registration not being accepted to compete. Teams are encouraged to register early.

10.6.3.   Other forms of down selection may be used to reduce the number of teams able to execute the mission. This may be implemented as the competition timeline progresses and depends on the team's timely submission and content of: Fact Sheets and Proof-of-Flight video; Technical-Journal Papers; Oral Presentations; and Safety Inspections. Schools may be limited to entering ~~more than one team~~ a single team.

10.6.4.   Some of the down-selection process can occur after the withdraw deadline has passed, at which time the team **shall** forfeit its ability to collect a refund.

10.6.5.   As with all official information, this announcement (should it be necessary) will appear on the Seafarer's website or by e-mails to the team's Captain and advisor.

10.7.   TEAM PARTICIPATION

10.7.1.   Teams do not need to compete in all portions of the competition to win prizes. If a team submits a journal paper, but cannot attend the competition days, they may still win a cash prize for ranking of the journal paper. Likewise a team could submit a journal paper and give their oral brief without performing the flight-mission demonstration and still receive prizes. This might occur due to a crash of their aircraft shortly prior to the competition.

10.7.2.   Prerequisites for participation in the flight-mission demonstration phase include successful submission of a technical journal paper, successfully passing the safety inspection and presenting the oral briefing FRR where judges assess the team's readiness for flight is acceptable.

10.8.   TEAM MEMBERSHIP

10.8.1.   Full-time undergraduate or high school students including no more than one graduate student **shall** compose the team.

10.8.2.   If a faculty advisor, non-student, or AUVSI Staff is used as the aircraft pilot, they are not counted as team members.

10.8.3.   Members from industry, government agencies, or universities (in the case of faculty or additional graduate students) may advise the team; however, they should not directly contribute in the creation of the design, test, paper, or presentation.

10.8.4.   The faculty member/advisor will sign a statement that the team consisted of no more than one graduate student and submit it with the team list(roster) stating the names of each student/advisors and confirming they are enrolled in the school as fulltime students or confirming that they meet the part-time student criteria defined below.

10.8.5.   Each team will be restricted to no more than ten (10) student/advisor participants.

10.8.6.   Each team will be limited to the number of accompanying guests (school, family, associates, etc.).

10.8.7.   Only the approved registered student from each team will be covered by competition expenses (food, shirts, etc.). Any additional team or accompanying members will be required to pay for their expenses.

10.8.8.   University participants shall be considered "students" if they are enrolled at their schools for at least 12 credit hours or more per quarter or semester during winter and spring, or if they are officially enrolled in the schools Co-Op program and defined as a full-time student. The status of any Co-Op student shall be

documented by the team's advisor and student's employer in a letter to the Seafarer Chapter to confirm Co-Op status and affirm the student will not be working on the team's UAS design when employed. Winter or Spring graduating seniors are not considered as grad students for this competition.

10.8.9.   High school students **shall** be enrolled at their schools according to the county, state, or country requirements. Home-schooled high school students are welcome to join other high school teams or create their own team.

10.8.10.   Registered teams **shall** provide the information required in Appendix I, SUAS Team General Composition Table **shall** be submitted by the deadline in the Schedule of Section 3.

10.8.11.   Each team **shall** have a formal school faculty member/advisor or official point of contact (POC) from the team's school that **shall** state in writing to the SUAS committee that the school knows the team is representing the school, that the team is traveling for the competition, and that this is done in compliance with Section 10.8.4. College teams whose entire team is age 18 years or above are not required to have the advisor or school official travel with the team. For any college team with a member younger than 18 years of age, and for all high school teams, at least two adults who are a school advisor and/or parent **shall** travel with the team and **shall** take full responsibility for the students. The teams' advisor's name and contact information **shall** be provided with the registration application form to be accepted. The team's advisor will be contacted during the SUAS registration acceptance process.

10.9. **STUDENT PARTICIPATION**

10.9.1.   The student members of a team **shall** make significant contributions to the development of their entry.

10.9.2.   One student member of the team **shall** be designated as the "Team Captain." Only the Team Captain will speak for the team related to all aspects of the competition.

10.9.3.   Teams registering to compete **shall** indicate on their application form the name of the individual or organization to whom prize checks will be made payable.

10.9.4.   Advisors may operate as safety pilots and may communicate to the team in the safety pilot role. These advisors **shall** be counted as a team member.

10.9.5.   Advisors **shall** not coach or participate with the team on non-safety conduct of the mission. Faculty and/or advisors cannot do anything but be the safety pilot during the competition. Students **shall** operate the systems, present data analysis, etc. in all phases of the competition.

10.10. **GOVERNMENT FACILITIES**

10.10.1. The AUVSI Seafarer Chapter of SUAS Competition **shall** be conducted aboard:

10.10.1.1. Naval Air Station (NAS) Patuxent River, Maryland (MD), Webster Field.

10.10.2. All personnel attending the SUAS Competition **shall** be cleared for access to Webster Field. For team members, faculty, or guests that are United States citizens, the information required in Appendix J, US Citizen Base Access Form **shall** be submitted by the deadline in the Schedule of Section 3.

10.10.2.1. Name, Date of Birth, Place of Birth, and Social Security Number.

10.10.3. All non-U.S. citizens, and those U.S. citizens who were born outside the U.S., **shall** submit a copy of a passport, visa, or naturalization certificate.

10.10.4. All non-U.S. citizens **shall** be escorted when on-site at Webster Field.

10.10.5. If teams require letters of invitation to the competition, a request for a letter **shall** be addressed to SUAS Competition Director along with the registration application.

10.10.6. For international teams or U.S. teams with non-U.S. citizens, the information required in Appendix K, Foreign National Base Access Form **shall** be submitted by the deadline in the Schedule of Section 3.

    10.10.6.1. A letter on College or University letterhead, signed by an official school administrator **shall** be provided.

10.10.7. International teams must begin the process very <u>early</u> in order to obtain passports and Visas so that the required data can be submitted to Navy Security officials in order to gain access to Webster Field, and to allow international travel in the U.S.

    10.10.7.1. In past competitions, some teams have not been able to travel because they delayed in obtaining passports and visas.

10.10.8. All non-U.S. citizens (members, students, or visitors) must receive proper base access badge and vehicle passes, and be escorted on base by authorized SUAS representatives.

    10.10.8.1. Any non-U.S. citizens who submit their passports or visas after the deadline defined in the Section of Section 3 **shall** NOT be granted access to Webster Field.

10.10.9. Officials **shall** have the right to have any persons immediately escorted from the facility without notice.

10.10.10. Any violation of base security policy, by a team member or guest of a team will immediately result in the team forfeiting the competition and the removal of the entire team and guests from the base.

10.11. **BASIS FOR AWARDS**

10.11.1. The judging team will evaluate on a graduated basis the competitor's compliance to the requirements set forth in this solicitation.

10.11.2. Judges may award prize barrels for completing mission tasks (**subject to change, based on sponsorship funding**):

    10.11.2.1. An award may be given to the best overall safety approach/execution.

    10.11.2.2. Overall award for the best combined score from Journal, Oral Presentation (FRR), and Flight-Mission Demonstration.

10.12. **OFFICIAL PAYMENT OF PRIZE MONEY**

10.12.1. Plaques and/or prize money are awarded to the teams excelling in the competition's primary categories and achieving the select prize barrels.

10.12.2. Teams receiving prize money will be given checks for the specified prize amount at the Awards Banquet.

10.12.3. Checks will be made out for distribution to the academic, team or individual name specified on the team's application form.

10.13. **TEAM LOGISTICS**

10.13.1. Teams **shall** be responsible for all planning, execution and shipping costs (inclusive of all export rules and duties) for transportation of team personnel and equipment to/from the competition. No team **shall** ship equipment direct to the Navy's military base. Teams must coordinate shipping with their hotels and handle all associated affairs without any support from the SUAS committee.

10.13.2. Teams **shall** be responsible for all planning, execution and travel costs to/from the competition, including hotels and food outside the competition. The Seafarer Chapter, SUAS Committee or volunteers will not provide transportation from/to the airport or hotel, and/or the Navy's military base, for any student, team, or advisor.

10.13.3. Teams **shall** be responsible to for all change fees or cancelation fees associated with airline tickets and hotels reservations, even if the SUAS committee does not accept the team's registration application, or the team fails to meet any of the competition requirements and is down-selected or becomes disqualified.

Appendix A: Registration Application Form

# 2015 SUAS Competition Registration Application
>>> *NO HAND-WRITTEN ENTRIES ACCEPTED* <<<
13th Annual Student UAS Competition
June 17 - 21, 2015
NAS Patuxent River, Webster Field, MD.

1. School Name: _____

2. Team Name: _____

    2.1. Team Mailing Address: _____

    2.2. Team City, State/Province: _____

    2.3. Team Zip Code/Country: _____

3. Faculty Advisor Name: _____

    3.1. Telephone Number(s): _____

    3.2. Email address: _____

4. Team Captain Name: _____

    4.1. Telephone Number(s): _____

    4.2. Email address:: _____

5. Name on Check Prize Awards written to (**Important!**): _____

6. Sponsor(s), if any: _____

APPLICATION FORM and PAYMENT: Must be date/time stamped by DEADLINE in Rules, Section 3.
Registration Fee: $750.00 USD. (**Check or Money Order ONLY, NO Electronic Transfers**)
Checks Payable to: AUVSI Seafarer Chapter
Mailing Address (stated in Section 10 of the Rules):

    AUVSI Seafarer Chapter
    P.O. Box 141
    California, MD 20619

Appendix B: Fact Sheet and Flight Plan Table (General Content)
> NO HAND-WRITTEN ENTRIES ACCEPTED <

1.   School / Team Name:

_____

2.   Team Captain Point of Contact (name, email address, & phone number):

_____

3.   Team Advisor Point of Contact (name, email address, & phone number):

_____

4.   Estimate of number of team members that will travel and participate on-site: _____

5.   Basic description of fixed/rotary wing aircraft, payload systems, and ground control system:

_____

_____

_____

_____

_____

_____

_____

_____

6.   RF Transmitter details for all aircraft control system, payload systems and any voice communication
     radios (Mfr., model numbers, specifications, frequencies, bandwidths, channels, etc.):

_____

_____

_____

_____

_____

_____

7.   Fuel and/or battery type: _____

8.   Aircraft LxWxH dimensions (inches): _____

9.   Aircraft gross weight (lbs.): _____

10. Launchers Description (if used): _____

11. Number of Vehicles, Trailers and other large equipment that will be brought to the competition:

_____

_____

2015 SUAS Team Flight Plan Table

TEAM NAME: _____

	SECTION	TASK	YES	NO
PRIMARY	7.1	AUTONOMOUS FLIGHT TASK		
	7.2	SEARCH AREA TASK		
SECONDARY	7.3	AUTO DETECT, LOCALIZE, AND CLASSIFY (ADLC) TASK		
	7.4	ACTIONABLE INTELLIGENCE TASK		
	7.5	OFF-AXIS TARGET TASK		
	7.6	EMERGENT TARGET TASK		
	7.7	SIMULATED REMOTE INFORMATION CENTER (SRIC) TASK		
	7.8.6	INFRARED SEARCH TASK; IR Target - Primary		
	7.8.8	INFRARED SEARCH TASK; IR Target - Secondary		
	7.9	AIR-DROP TASK		
	7.10	INTEROPERABILITY TASK		
	7.11	SENSE, DETECT AND AVOID (SDA) TASK		

Appendix C: Map of Competition from 2014 SUAS (*EMAMPLE ONLY*)
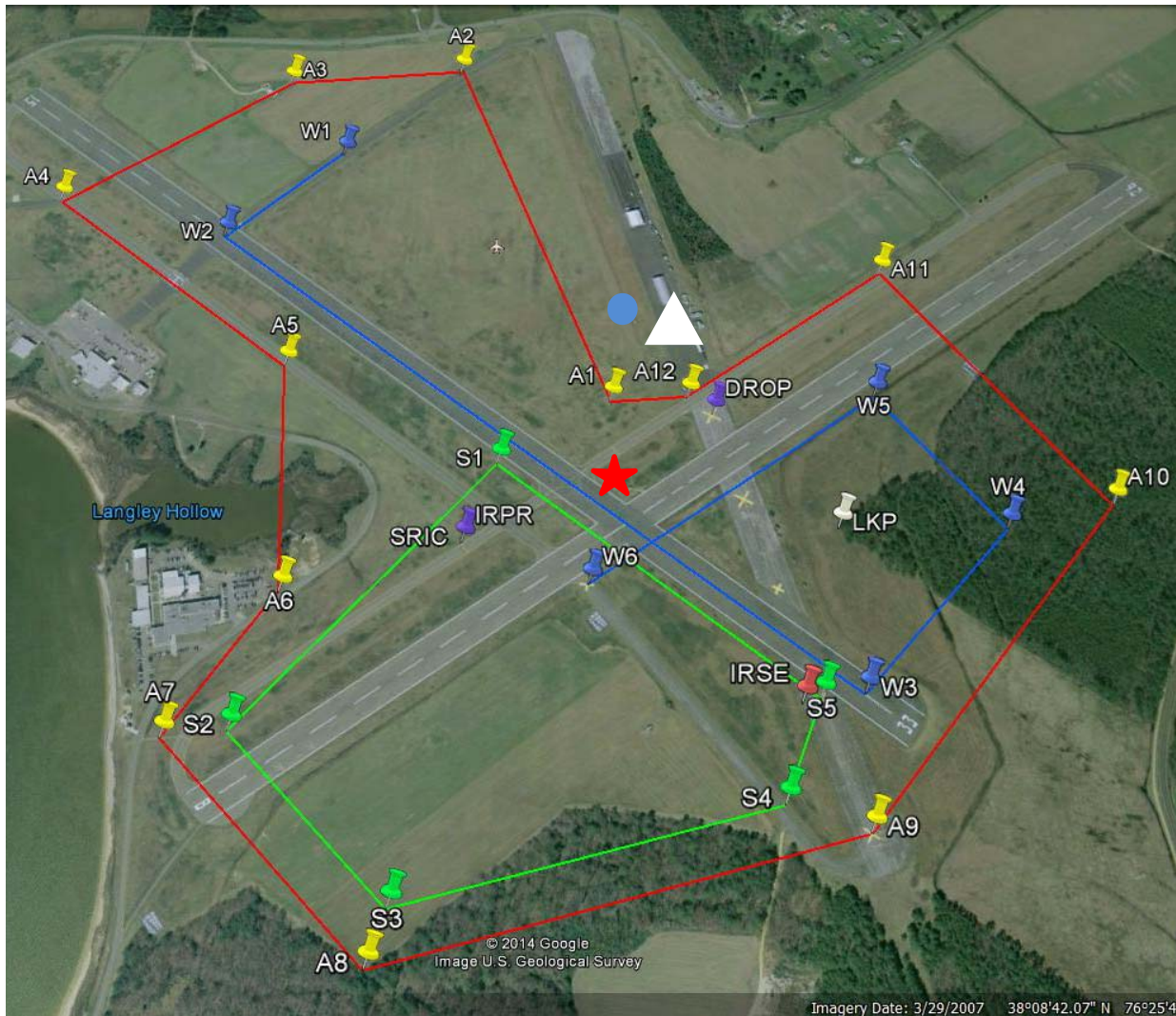
Map key (EXAMPLE ONLY - 2015 Boundary, Waypoints, Search Area data will be provided later!)

- Red outline: No-fly-zone boundary

- Blue outline: Waypoint sequence

- Green outline: Target search area

- Yellow pins: Boundary judge stations

- White Triangle: Pit Area Tents

- Red Star: Flight Line Tents

- Blue Circle: Off-axis target

- SRIC, IRPr, IRSE, DROP, LKP markers: (THESE ARE *NOT* ACTUAL LOCATIONS FOR 2015)

Appendix D: Electronic Target Data Format

Name the file using the initials of your school or team as a text file (.txt). Example: JHU.txt

9 fields, tab delimited, new target on each line. Example for two targets:

1	2	3	4	5	6	7	8	9	10	11
01	STD	N30 35 34.123	W075 48 47.123	N	rectangle	red	A	orange	T1.jpg	AutoDetect
02	STD	S34 00 12.345	E002 01 12.345	SE	square	orange	4	yellow	T2.jpg	Actionable Intel
03	QRC	N51 28 40.125	W000 00 05.310						T3.jpg	www.example.edu
04	EMG	N38 53 19.680	W077 01 12.000						T4.jpg	fire fighter….
05	OAX			E	triangle	green	F	white	T5.jpg	
06	IRS			SW			8		T6.jpg	
07	IRA			NW					T7.jpg	arrow moving NW

<u>Field 1</u> - Target number, two digits, starting at 01 and increment by one for each additional target. Target number is assigned by team.
Example: 01, 02, 03, etc.

<u>Field 2</u> - Target Type in 3 digit form: Standard = STD, Quick Reaction Code = QRC, Off-Axis = OAX, Emergent = EMG, IR Static = IRS, IR Active = IRA

<u>Field 3</u> - Latitude in the following format: first character N or S, two digit degrees (use leading zeros if necessary), followed by space, two digit minutes, followed by space, two digit seconds followed by decimal point and up to 3 digits (thousandths of a second)
Example: N30 35 34.123

<u>Field 4</u> - Longitude in the following format: first character E or W, three digit degrees (use leading zeros if necessary), followed by space, two digit minutes, followed by space, two digit seconds followed by decimal point and up to 3 digits (thousandths of a second)
Example: W075 48 47.123

<u>Field 5</u> - Target orientation, up to two characters
Example: N, NE, E, SE, S, SW, W, NW

<u>Field 6</u> - Target shape; list geometric shape as appropriate:
Example: rectangle, square, triangle

<u>Field 7</u> - Target color, as appropriate.
Example: Red, Orange, Yellow, etc.

<u>Field 8</u> - Alphanumeric, as appropriate
Example: A, b, 2, &

<u>Field 9</u> - Alphanumeric color, as appropriate
Example: Red, Orange, Yellow, etc.

<u>Field 10</u> - Name of JPEG file with image of target
Example: T1.jpg

<u>Field 11</u> – Amplifying Text, as appropriate.
Example: "Actionable Intelligence", "Automatic Detections", emergent target description, Active IR target description, etc.

Appendix E: Target Score Sheet (Example)

Team: _____
Standard Target, Actionable Intelligence and Off-Axis Target

Target # _____ Action Intel? Y Off-Axis: Y	Target # _____ Action Intel? Y Off-Axis: Y
Latitude (except Off-Axis Target): (N/S ddd mm ss.sss)	Latitude (except Off-Axis Target): (N/S ddd mm ss.sss)
Longitude (except Off-Axis Target): (E/W ddd mm ss.sss)	Longitude (except Off-Axis Target): (E/W ddd mm ss.sss)
Orientation: (N, NE, E, SE, S, SW, W, NW)	Orientation: (N, NE, E, SE, S, SW, W, NW)
Shape:	Shape:
Background Color:	Background Color:
Alphanumeric:	Alphanumeric:
Alphanumeric Color:	Alphanumeric Color:
Target # _____ Action Intel? Y Off-Axis: Y	Target # _____ Action Intel? Y Off-Axis: Y
Latitude (except Off-Axis Target): (N/S ddd mm ss.sss)	Latitude (except Off-Axis Target): (N/S ddd mm ss.sss)
Longitude (except Off-Axis Target): (E/W ddd mm ss.sss)	Longitude (except Off-Axis Target): (E/W ddd mm ss.sss)
Orientation: (N, NE, E, SE, S, SW, W, NW)	Orientation: (N, NE, E, SE, S, SW, W, NW)
Shape:	Shape:
Background Color:	Background Color:
Alphanumeric:	Alphanumeric:
Alphanumeric Color:	Alphanumeric Color:
Target # _____ Action Intel? Y Off-Axis: Y	Target # _____ Action Intel? Y Off-Axis: Y
Latitude (except Off-Axis Target): (N/S ddd mm ss.sss)	Latitude (except Off-Axis Target): (N/S ddd mm ss.sss)
Longitude (except Off-Axis Target): (E/W ddd mm ss.sss)	Longitude (except Off-Axis Target): (E/W ddd mm ss.sss)
Orientation: (N, NE, E, SE, S, SW, W, NW)	Orientation: (N, NE, E, SE, S, SW, W, NW)
Shape:	Shape:
Background Color:	Background Color:
Alphanumeric:	Alphanumeric:
Alphanumeric Color:	Alphanumeric Color:

Team: _____   **Autonomous Detection Targets**

Target # _____ Standard? Y QRC: Y	**Target # _____ Standard? Y QRC: Y**
Latitude: (N/S ddd mm ss.sss)	Latitude: (N/S ddd mm ss.sss)
Longitude: (E/W ddd mm ss.sss)	Longitude: (E/W ddd mm ss.sss)
Orientation (Standard Target Only): (N, NE, E, SE, S, SW, W, NW)	Orientation (Standard Target Only): (N, NE, E, SE, S, SW, W, NW)
Shape (Standard Target Only):	Shape (Standard Target Only):
Background Color(Standard Target Only):	Background Color(Standard Target Only):
Alphanumeric(Standard Target Only):	Alphanumeric(Standard Target Only):
Alphanumeric Color (Standard Target Only):	Alphanumeric Color (Standard Target Only):
Message (QRC Only):	Message (QRC Only):
Target # _____ Standard? Y QRC: Y	**Target # _____ Standard? Y QRC: Y**
Latitude: (N/S ddd mm ss.sss)	Latitude: (N/S ddd mm ss.sss)
Longitude: (E/W ddd mm ss.sss)	Longitude: (E/W ddd mm ss.sss)
Orientation (Standard Target Only): (N, NE, E, SE, S, SW, W, NW)	Orientation (Standard Target Only): (N, NE, E, SE, S, SW, W, NW)
Shape (Standard Target Only):	Shape (Standard Target Only):
Background Color(Standard Target Only):	Background Color(Standard Target Only):
Alphanumeric(Standard Target Only):	Alphanumeric(Standard Target Only):
Alphanumeric Color (Standard Target Only):	Alphanumeric Color (Standard Target Only):
Message (QRC Only):	Message (QRC Only):
Target # _____ Standard? Y QRC: Y	**Target # _____ Standard? Y QRC: Y**
Latitude: (N/S ddd mm ss.sss)	Latitude: (N/S ddd mm ss.sss)
Longitude: (E/W ddd mm ss.sss)	Longitude: (E/W ddd mm ss.sss)
Orientation (Standard Target Only): (N, NE, E, SE, S, SW, W, NW)	Orientation (Standard Target Only): (N, NE, E, SE, S, SW, W, NW)
Shape (Standard Target Only):	Shape (Standard Target Only):
Background Color(Standard Target Only):	Background Color(Standard Target Only):
Alphanumeric(Standard Target Only):	Alphanumeric(Standard Target Only):
Alphanumeric Color (Standard Target Only):	Alphanumeric Color (Standard Target Only):
Message (QRC Only):	Message (QRC Only):

Team: _____

Emergent Target, Quick Reaction Code Target and IR Targets

| Target # _____ EMERGENT TARGET	Target # _____ QUICK REACTION CODE TARGET
Latitude: (N/S ddd mm ss.sss)	Latitude (except Off-Axis Target): (N/S ddd mm ss.sss)
Longitude: (E/W ddd mm ss.sss)	Longitude (except Off-Axis Target): (E/W ddd mm ss.sss)
Description: _____ _____ _____	Text: _____ _____ _____
Target # _____ QUICK REACTION CODE TARGET	**Target # _____ QUICK REACTION CODE TARGET**
Latitude: (N/S ddd mm ss.sss)	Latitude (except Off-Axis Target): (N/S ddd mm ss.sss)
Longitude: (E/W ddd mm ss.sss)	Longitude (except Off-Axis Target): (E/W ddd mm ss.sss)
Text: _____ _____ _____	Text: _____ _____ _____
Target # _____ IR PRIMARY TARGET	**Target # _____ IR SECONDARY TARGET**
Orientation: (N, NE, E, SE, S, SW, W, NW)	Orientation: (N, NE, E, SE, S, SW, W, NW)
Symbol:	Symbol: _____ _____
SECRET MESSAGE	
  _____	

Appendix F: SRIC Details
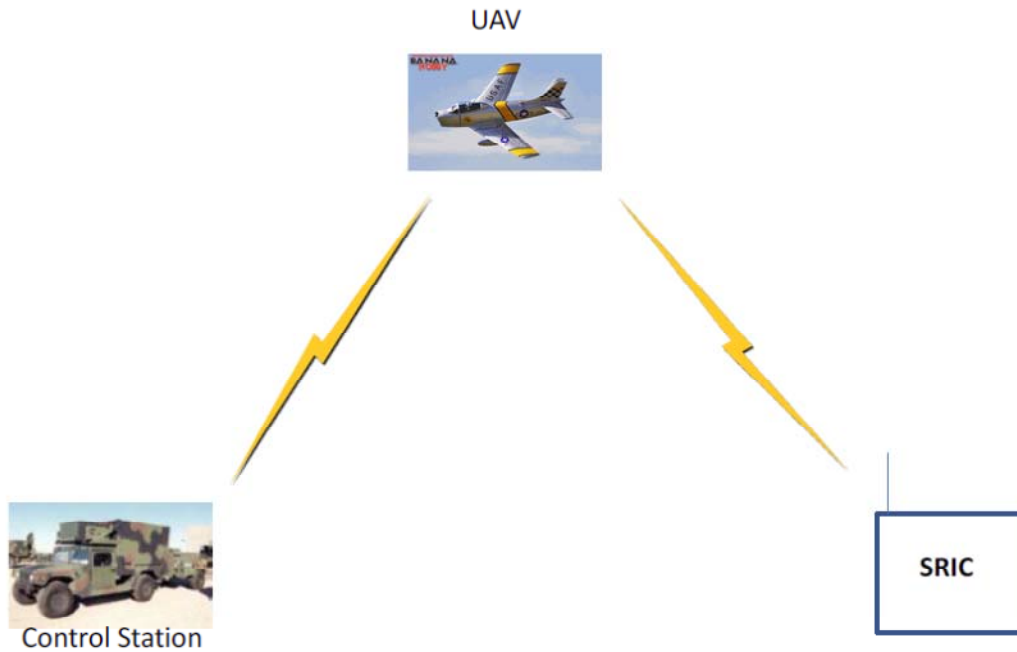
FIGURE 1: SRIC CONNECTION DIAGRAM

1.0   **General**

    1.1   **Scope:** This document provides or references the data definitions required for transfer of data from the Simulated Remote Information Center (SRIC) to the competing team's UAS. These definitions encompass the data link and message interfaces.

2.0   **Equipment Definition:**

    2.1   The SRIC will comprise of a laptop computer running Microsoft Windows 7, a Linksys Model WRT54GL Wireless Broadband Router, a 10 dB attenuator, and a TRENDnet Model TEW-A014D High-gain directional antenna. The SRIC block diagram is shown in Figure 2.
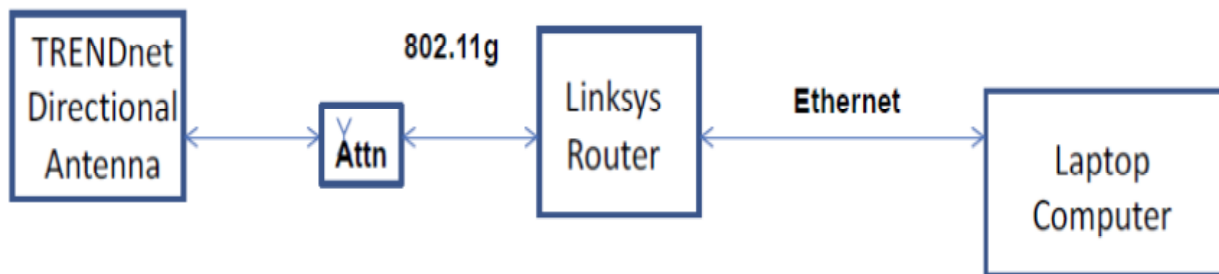

FIGURE 2: SRIC BLOCK DIAGRAM

2.2   The Linksys WRT54GL Router and the Linksys URL are shown in Figure 3.

2.3   The TRENDnet Model TEW-A014D High-gain Directional Antenna and the TRENDnet URL are shown in Figure 4.

FIGURE 3: SRIC ROUTER

http://homedownloads.cisco.com/downloads/WRT54GL_V11_DS_NC-WEB,0.pdf

FIGURE 4: SRIC ANTENNA

http://www.trendnet.com/products/proddetail.asp?prod=145_TEW-AO14D&cat=926

3.0   **APPLICABLE DOCUMENTS**

3.1   IEEE 802.11g specification available at:
http://standards.ieee.org/about/get/802/802.11g.html

4.0   **INTERFACE DESCRIPTIONS**

4.1   **Logon Procedures**: Each team will be provided unique logins, including both username and password.

4.1.1   The antenna location and the wireless network name will be provided at the Check-in and Orientation event.

4.1.2   The router IP address, netmask, and static IP Address, network passphrase, and folder name will be provided by the Lead Judge at the start of setup time on the flight line.

4.1.3   Students will be allowed to test the network connection during the practice day.

4.1.4   The student teams **shall** use Wired Equivalent Privacy (WEP) encryption when accessing SRIC.

4.1.5   When flying in the specified area, connect to the network. The router will be located on wireless channel 1 at 2.412 GHz.

4.1.6   Enter the provided network passphrase.

4.1.7   Dynamic Host Configuration Protocol (DHCP) will be enabled. If dynamic IP is not used, a static IP address will be provided.

4.1.8   After network connection is confirmed, enter the provided IP address.

4.1.8.1 An example for Team 1 is below: FTP://192.168.1.110/auvsi/team1.

4.1.9   Open the folder and find a unique team file within the folder. This folder will be read only.

4.1.10 Follow the SUAS rules to allow the judges to score the team's success in opening the folder and accessing the unique team file within the folder.

4.2   **Antenna Patterns**

4.2.1   The directional antenna patterns are shown in Figure 5.
4.2.1.1 **NOTE:** The air vehicle MUST stay within the SRIC beamwidth to log into the network, receive the secret word, and uplink imagery.

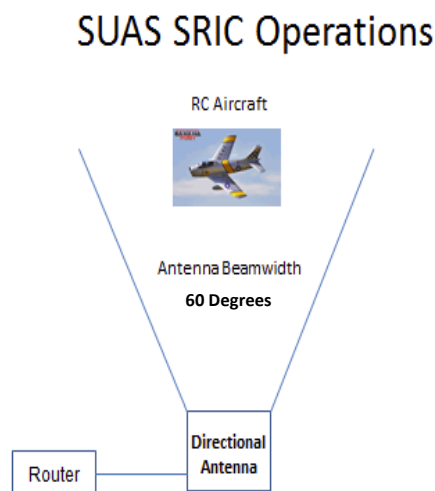**FIGURE 5: DIRECTIONAL ANTENNA PATTERN**

Appendix G: Interoperability Specifications

1. This section gives the Interoperability Specification, which includes how to setup the physical network, how to configure the network, where to find specifications for the interoperability interface, and what the interoperability deliverables should look like.

2   Interoperability Network.

2.1   The judges will provide the interoperability network during the competition. Multiple teams may be connected to the network at one time. Care will be taken to ensure that the network is partitioned through components like VLAN, IP range restrictions, and web authentication. This section describes what is necessary to develop and test interoperability.

2.1.1   Network Hardware. The hardware required is a router, 2 Ethernet cables, and 2 computers. One computer will act as the interoperability web server, and at competition the judges will provided it. The other computer will be provided by the team and will contain software that performs the interoperability task. The Ethernet cables will be provided and will be standard Cat5e cables for gigabit Ethernet. Both computers do not need to support gigabit Ethernet, but they should be able to provide 100 Mbps full duplex. The router provided will be a Linksys WRT54GL. Although this is the same router model as the SRIC task, two separate routers will be used during the competition. The two networks, one for SRIC and one for interoperability, will remain unconnected. The Wi-Fi on the router for interoperability will be disabled.

2.1.2   Network Setup. To setup the network, connect one Ethernet computer from the team's computer to the router. Connect another Ethernet computer from the router to the computer that will operate the interoperability web server. The router will be configured to assign DHCP addresses in a specific range, and accept static IP addresses in a separate range. The two ranges will be provided at the competition. The IP addresses will be on the subnet 10.10.130.XXX with subnet mask 255.255.255.0.
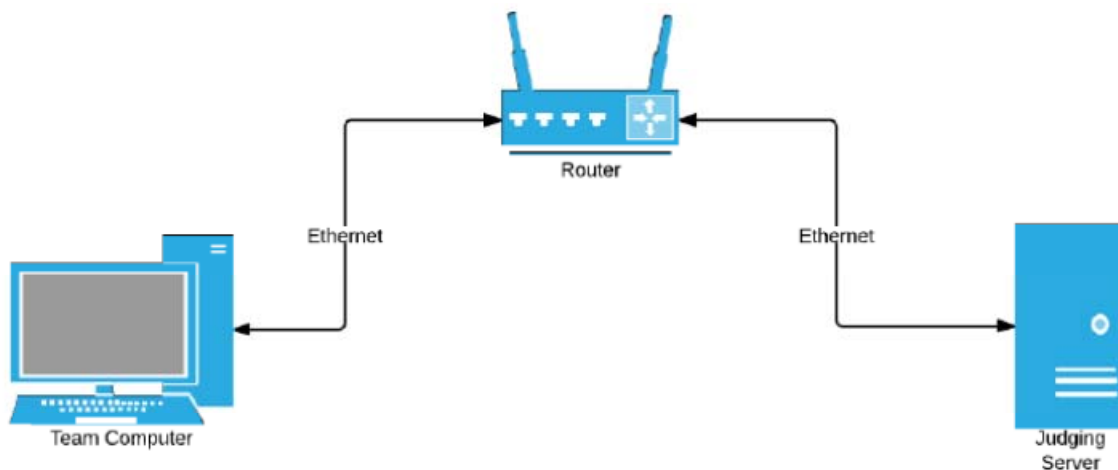

FIGURE G-1

2.1.3   Network Stack. The interoperability web server will communicate via HTTP over TCP/IP. Requests will be generated by the team's software, it will be forwarded over the network, and it will be delivered to the web server. The web server will interpret the URL and HTTP parameters provided to form an appropriate response. The response will then be forwarded back to the team's software. The web server will provide appropriate error messages should the request be incorrect or a problem occur. Teams should display these errors for debugging during a mission.
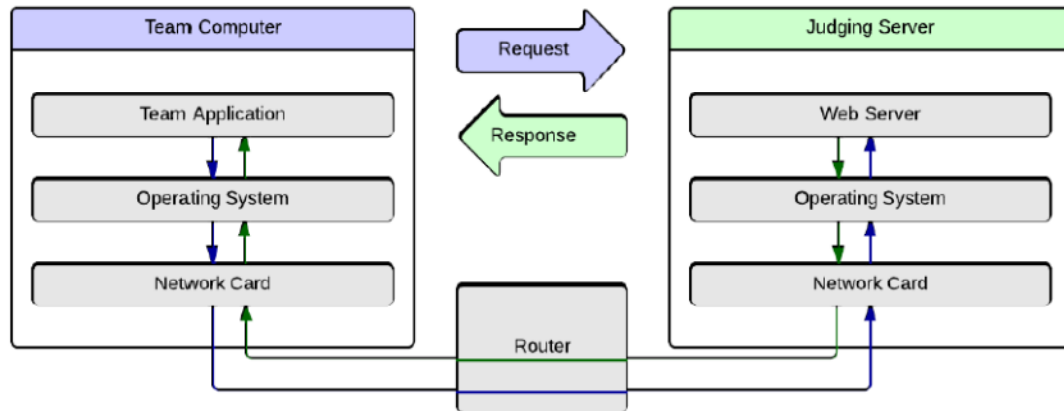

FIGURE G-2

2.2   Code Repository.

2.2.1   The code for the interoperability web server is on the Code Repository. The repository is hosted on Github and includes a Wiki for documentation. The Wiki contains instructions for how to checkout (download) the Code Repository. Cloning (downloading) and viewing the repository can be done by anybody (public), but pushing (uploading) to the repository is restricted. The repository contains the URL specifications, the JSON specifications, and the processing logic for the server. The source code is provided so that teams can get a better understanding of how the server is implemented, and so that teams can debug their implementations. The Wiki contains documentation for the source code, the URL formats, and the JSON specifications. It also contains documentation for how to setup the server, how to configure the server, how to start the server, how to stop the server, and how to view server logs. The server logs will contain information useful for debugging implementations.

2.2.1.1   The repository can be found here:
https://github.com/pmtischler/auvsi_suas_competition

2.2.1.2   The Wiki can be found here:
https://github.com/pmtischler/auvsi_suas_competition/wiki

Appendix H: Notice of Risk; Disclaimer of Liability; Waiver of Claims Form

I.   **NOTICE OF RISK; DISCLAIMER OF LIABILITY; WAIVER OF CLAIMS**

    1.   Activities associated with the Student UAV Competition can at times involve substantial risk of injury, property damage, and other dangers associated with participation in the event. Dangers peculiar to such activities include, but are not limited to: hypothermia, drowning, broken bones, stains, sprains, bruises, concussion, heart attack, heat exhaustion, cuts, abrasions, burns, electrical shock, poisoning, and blunt trauma.

Check 2a or 2b:
    2a.   I have no serious health issues or problems that would preclude me from participating in this competition or that present an abnormal, unusual or unreasonable risk of, or susceptibility to, injury.

_____ Initials   _____ Date

    2b.   I have a disability which I have disclosed to the competition officials, and I have:

Check (i) or (ii):
    (i) not requested any reasonable modifications in policies, practices or procedures.

_____ Initials   _____ Date

    (ii) requested reasonable modifications in policies, practices, or procedures which will not fundamentally alter the nature of the competition.

_____ Initials   _____ Date

_____ Initials   _____ Date

    3.   Each sponsor, participant, judge, hired service provider, volunteer, or staff member in the Student UAV Competition should realize that there are inherent risks, hazards, and dangers involved including transport of equipment, preparation for competing, training/testing, travel to and from the event, and, of course, competing in the event itself. It is the responsibility of each person involved to engage only in those activities from which s/he has the prerequisite skills, qualifications, preparation, and training.

_____ Initials   _____ Date

II.   **ACKNOWLEDGEMENT AND ASSUMPTION OF RISK**

    4.   I have read the above notice carefully and acknowledge receipt of a copy thereof. In consideration of the benefits received, I hereby assume all risks of damages or injury, including death, that I may sustain while participating in or as a result of, or in any way growing out of my activity associated with the Student UAV Competition.

    5.   In particular, without limiting the generality of the foregoing, I fully understand and acknowledge that there are risks and dangers associated with participation in the Student UAV Competition events and activities which could result in bodily injury, partial and/or total disability, paralysis and death. The social and economic losses and/or damages to me, my family and others, which could result from these risks and dangers described above, could be severe. These risks and dangers may be caused by my own action, inaction or negligence or the action, inaction or negligence of others, including, but not limited to, the Association for Unmanned Vehicle Systems International (AUVSI), its members individually and its officers, agents and volunteers and employees, the competition organizer, the organizer's family and estate, and the United States Government and its employees and agents (hereafter, collectively referred to as the "Releasees"). There may be other risks not known to us or not reasonably foreseeable at this time.

    6.   I accept and assume such risks and responsibility for the losses and/or damages following such injury, disability, paralysis or death, however caused and whether caused in whole or in part by the negligence of the Releasees named above.

_____ Initials   _____ Date

Notice of Risk; Disclaimer of Liability; Waiver of Claims – Student UAV Competition   Page 1 of 2

III. RELEASE AND WAIVER OF LIABILITY AND COVENANT NOT TO SUE (READ CAREFULLY BEFORE SIGNING)

7.   I hereby acknowledge that participation in risk oriented programs and activities involves an inherent risk of physical injury and I assume all risks. I hereby agree that for the sole consideration of AUVSI's and the U.S. Government's allowing me to participate in the Student UAV Competition for which the United States Government has made available facilities, equipment, grounds, and personnel, and the AUVSI has made available equipment, awards, and volunteer staff, I, for myself, my personal representatives, assigns, executors, heirs and next of kin, do hereby release and forever discharge the Releasees from and of any and all claims, demands, rights and causes of action of whatever kind or nature, arising from and by reason of any and all known and unknown, foreseen and unforeseen bodily and personal injuries (INCLUDING BUT NOT LIMITED TO THE DEATH OF THE PARTICIPANT OR DAMAGE TO PROPERTY), damage to property, and the consequences thereof, whether or not caused or contributed to in whole or in part by the negligence of the Releasees, resulting from any participation in any way connected with the Student UAV Competition.

8.   I further expressly agree that the foregoing release, waiver, and covenant not to sue is intended to be as broad and inclusive as is permitted by the law of the State in which the event is conducted.

9.   I further covenant and agree that for the consideration stated above, I will not sue the Releasees for any claim for damages arising or growing out of my participation in the Student UAV Competition. I understand that the acceptance of this release and covenant not to sue the Releasees shall not constitute a waive in whole or in part, or any sovereign or official immunity which may be possessed by any of the Releasees.

10.   I have received a copy of this document and I certify that I am ___ years of age and suffering under no legal disabilities and that I have read the above carefully before signing.

11.   This entire agreement, including the notice, assumption of risk, and release, waiver of liability and covenant not to sue shall be construed and applied so as to conform to the law of the State whose laws are deemed to be controlling. In the event any clause of this agreement shall be deemed not to be in compliance with applicable law, that clause shall be either be given no force or effect, or shall be construed and applied to conform to State law, the validity and enforceability of all other clauses and of the agreement itself otherwise not being affected.

12.   I HAVE READ THIS RELEASE AND WAIVER OF LIABILITY, ASSUMPTION OF RISK AND COVENANT NOT TO SUE AGREEMENT, FULLY UNDERSTAND ITS TERMS, UNDERSTAND THAT I HAVE GIVEN UP SUBSTANTIAL RIGHTS BY SIGNING IT, AND HAVE SIGNED IT FREELY AND VOLUNTARILY WITHOUT ANY INDUCEMENT, ASSURANCE, OR GUARANTEE BEING MADE TO ME AND INTEND MY SIGNATURE TO BE COMPLETE AND UNCONDITIONAL RELEASE OF ALL LIABILITY TO THE GREATEST EXTENT ALLOWED BY LAW.

_____   _____
Name   Date

_____   _____
Signature   Signature of Parent or Guardian (If participant is under 18)

_____   _____
Witness   Witness

Notice of Risk; Disclaimer of Liability; Waiver of Claims – Student UAV Competition   Page 2 of 2

Appendix I: SUAS Team General Composition Table

SUAS Team General Composition Table
> NO HAND-WRITTEN ENTRIES ACCEPTED <

TEAM NAME _____   **DATE** _____

#	COMMENT/QUESTION	Numbers
1	How many team members, including the team advisor, will arrive and compete at NAWCAD Webster Field?	
2	How many team members, including the team advisor, are Foreign Nationals and require special Base Access to NAWCAD Webster Field?	
3	How many non-team members and support group, will arrive and require access to NAWCAD Webster Field?	
4	How many team members have vegetarian dietary needs?	
5	How many/size T-shirts (S, M, L, XL, XXL) for "team" members are required? Small = _____ Medium = _____ Large= _____. Extra Large = _____ Extra Large =_____	
COMMENTS		

Appendix J: US Citizen Base Access Form

U.S. CITIZEN VISITOR
Base Access Information Data

Teams **shall** submit a complete list of all team members and faculty advisors (with Faculty designated), and any observers, family members or guests as a group associated with the team.

Personal information is required for all participants or guests who will attend the Student UAS Competition at Webster Field, St. Inigoes, Maryland.   The SUAS Competition Committee will require the following information for each participant:

1. Full Name:
2. Date of Birth:
3. Place of Birth:
4. Social Security Number:
5. If any U.S. citizen was born outside the United States, also include a photo copy of a naturalization certificate or other documentation of their U.S. citizenship.

Required data is due NO LATER THAN the deadline date listed in Section 3.0 Schedule.

Please <u>mail</u> this data to the <u>*AUVSI Seafarer Chapter*</u> address defined in Section 10.
     AUVSI Seafarer Chapter
     P.O. Box 141
     California, MD 20619

Arranging Base Access is a major task with the number of participants we expect this year, and we need your cooperation and help to get the data to us as early as possible.

Thanks in Advance for your attention to these details.

Appendix K: Foreign National Base Access Form

<u>FOREIGN NATIONAL VISITOR</u>
Base Access Information Data

Every team that will have foreign nationals as members or visitors must provide a letter listing all of the Foreign Nationals. All foreign students, faculty, or guests from the same university may be added on one letter.

Visitation is limited to the dates of the competition at NAS Patuxent River and Webster Field, MD.

<u>Purpose of visit</u>: **UNCLASSIFED**, Students from this <u>*University or College*</u> will participate in the Association for Unmanned Vehicle Systems International (AUVSI) 2014 Student UAS Competition to be held at Webster Field, St. Inigoes, Maryland. Student teams will present an oral brief on the airplane and system they have built to fly in the competition and will fly the vehicle around a prescribed course at Webster Field under the guidance and supervision of NAVAIR Government personnel and other AUVSI officials.

Prepare a letter with the information requested below for each foreign national on **university letterhead** and **signed** by a responsible university official. Provide the information requested in blue below, copy and include the information in black describing the dates, purpose, and government point of contact. Someone other than persons listed on the request must sign the letter (a Dean, Department Head, or Senior Faculty official). **In addition to the information on the letter, also provide a photo copy of the passport or green card.**
1. Name: (legal name please)
2. Place of Birth (POB):
3. Date of Birth (DOB):
4. Country of Citizenship:
5. Country of Residence:
6. Title/position: (Team Lead, Team Member, Faculty Advisor, Guest)
7. Passport, Visa or Resident Alien "Green Card" number **(specify) and expiration date:**
8. **Include University address, and phone and fax numbers.**

Letters and photo copies are due NO LATER THAN the date listed in Section 3.0 Schedule.

Please <u>mail</u> this data to the <u>*AUVSI Seafarer Chapter*</u> address defined in Section 10.
> AUVSI Seafarer Chapter
> P.O. Box 141
> California, MD 20619

Arranging Base Access is a major task with the number of participants we expect this year, and we need your cooperation and help to get the data to us as early as possible.

Thanks in Advance for your attention to these details.