

**2011 Undergraduate Students Unmanned Aerial Systems Competition
AUVSI**

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SECTION A CONCEPT OF OPERATIONS

A company of US Marines is conducting a patrol. Your unmanned aerial system (UAS) is supporting their sweep with intelligence, surveillance and reconnaissance (ISR). In order to support them, your UAS must comply with Air Tasking Order (ATO) Special Instructions (SPINS) for departure and arrival procedures, and then remain within assigned airspace. It will be tasked to search an area for typical targets, and may be tasked to conduct an immediate route reconnaissance for convoy support or a point reconnaissance if requested. Immediate ISR tasking may be requested outside currently assigned airspace, causing the UAS operators to request deviations.

SECTION C DESCRIPTIONS AND SPECIFICATIONS
C-1 STATEMENT OF WORK FOR SEAFARER CHAPTER OF THE ASSOCIATION OF
UNMANNED VEHICLE SYSTEMS INTERNATIONAL (AUVSI) STUDENT
UNMANNED AERIAL SYSTEM (SUAS) COMPETITION

1.0 Introduction

1.1 This statement of work (SOW) defines the tasks to be performed by the competitor in performing all aspects of the SUAS competition.

1.2 The Seafarer Chapter of the Association for Unmanned Vehicle Systems International (AUVSI) continues the Student UAS Competition aimed at stimulating and fostering interest in unmanned systems, technologies and careers. The focus is on engaging students in systems engineering a total solution to a challenging mission, requiring the design, fabrication and demonstration of a system capable of completing a specific autonomous aerial operation.

Student teams will be judged based on their system performance, and top teams will earn prize money. Opportunities for interaction with top UAS designers, engineers, scientists and leadership will be provided.

1.3 The principal thrusts of the competition are the safe application and execution of Systems Engineering to develop autonomous operation in successful mission accomplishment.

1.4 The major graded items/events are:

1.4.1 Final Journal Paper

1.4.2 Oral Presentation /Flight Readiness Review

1.4.3 Flight Demonstration

2.0 Scope. This is a Performance-Based competition. Multiple government agencies, prime contractors, engineering firms and Universities are observing and judging this competition. Contestants may be awarded prizes for major graded items/event, overall performance or individual aspects of a graded item/event.

3.0 Requirements. The Statement of Work for this competition is laid out in paragraph format in line item number order to facilitate tracking and task identification. Technical support tasks, documentation and products should be provided in accordance with the Statement of Work.

3.1 System Design & Development (SDD). There are no graded events during SDD – this SOW task is entirely to aid the competitor to understand the requirements and the systems engineering process. Each team will establish its own Plan of Action and Milestones (POA&M) to complete SDD within the time available before the graded Flight Demonstration. Teams may compress, consolidate or eliminate suggested reviews (at their peril).

3.2 Fact Sheet. Six weeks prior to the competition (May 2, 2011) a one-page fact sheet providing basic descriptions of the air vehicle and systems shall be submitted to AUVSI Seafarer Chapter. It shall include frequencies used for air vehicle control (manual or autonomous) and payload control/imagery receipt, fuel and/or battery type and air vehicle dimensions including gross weight.

3.3 Journal Paper. Each team is required to electronically submit a journal paper that describes the design of their entry and the rationale behind their design choices. The paper shall include an abstract, description of the systems engineering approach, descriptions of the UAS design, test and evaluation results (including payload and navigation system performance), and safety considerations/approach. Systems engineering includes mission/requirements analysis, design rationale, and expected performance. Design descriptions are required for the air vehicle, ground control station, data link, payload, mission planning, data processing and method of autonomy and target types supported by autonomous cueing/recognition (if utilized). Specific attention shall be paid to safety criteria. The journal paper shall include a photo of the UAS air vehicle. The journal paper (including proof of flight video or statement) must be received by AUVSI Seafarer Chapter no later than May 23, 2011.

3.4 Oral Presentation. The Oral Presentation will not be a restatement of the Journal Paper. Instead, it will take the shape of a Test Readiness Review (FRR) during which the competitors will present the judges with

- 3.4.1 System Safety Overview
- 3.4.2 Results of developmental test (DT)
- 3.4.3 Evidence of likely Mission Accomplishment
- 3.4.4 Pre-Mission Brief
- 3.4.5 A static display describing the elements above

Only systems presented in the Flight Readiness Review, inspected by safety inspectors, and included in the preflight brief will be permitted to fly.

3.5 Flight Demonstration.

3.5.1 Takeoff - Takeoff shall take place within one of two designated Takeoff/Landing areas, depending on wind direction. This area will be paved asphalt surface, roughly 100 ft wide, with no height obstacles. Systems utilizing launchers and/or not performing wheeled landing may utilize the grass immediately adjacent to the runway; however, grass area will not be prepared. Takeoff from moving vehicles is prohibited. Launchers will be inspected by competition safety inspectors before they are allowed for use in the competition. After takeoff, the air vehicle shall maintain steady, controlled flight at altitudes above 100 feet and under 750 ft MSL (Note: airfield elevation is approximately 10 ft MSL). Takeoff under manual control with transition to autonomous flight is permitted. Extra credit and a cash award will be provided for autonomous Takeoff.

3.5.2 Waypoint Navigation – Air vehicles shall autonomously overfly selected waypoints and remain inside assigned airspace, and avoid no-fly zones. Teams will fly a predetermined course that includes changes in altitude and in heading, to and from the search area.

3.5.2.1 Waypoints - GPS coordinates (ddd.mm.ssss) and altitudes will be announced the day prior to the flight competition. However, because of the dynamic nature of modern warfare, it is possible that additional waypoint(s) and or search area adjustment(s) will be required.

3.5.2.2 Enroute Search – Air vehicles will be required to fly specific altitudes while identifying several targets along the predefined entry/exit route. One of the targets will be directly along the route when the vehicle is required to be at 500 ft MSL (± 50 ft). Another target will be up to 250 ft from the center of the flight path while the vehicle is required to be at 200 ft MSL (± 50 ft). The team will be given the position of the off-center target. UAS shall not vary from the flight paths (± 100 ft tolerance) briefed during the mission planning in order to obtain an image of the target; flight path deviations shall not be permitted as to avoid being shot down by hostile or friendly forces. Enroute way points shall be achieved in order.

3.5.2.3 Targets - Targets will be constructed of plywood of a given size, basic geometric shape, and color; for an example, see Figure 1. Each target will be a different shape and a unique color; a different color alphanumeric will be painted on each target. There are an unknown number of targets in the area. The additional target will be more reflective of a realistic surveillance target. The minimum dimension of the targets (length or width) will be 4 feet, and the maximum dimension will be 8 feet. Alphanumerics will be sized to fit within the overall dimensions of the target.

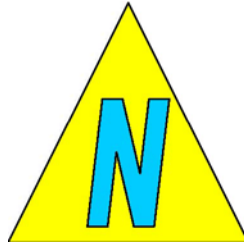


Figure 1

3.5.3 Area Search - once transitioning into the predefined search area via the entry/exit route, the air vehicle shall autonomously search for specific targets of interest. Air vehicles may search the area at any altitude between 100 and 750 ft MSL. Targets will be distributed throughout the search area. Competitors shall record the characteristics (location, shape, color, orientation, alpha, alpha color) of all observed targets on a target data sheet (and/or in electronic form) and provide this data to the judges at completion of the mission.

While executing the search mission, the team will be provided with a new search area (within the existing no fly zone boundaries) allowing you to locate “pop-up” targets. There will be a minimum of 200 ft margin between the search area and the no fly zone boundary.

3.5.4 Landing - Landing shall be performed completely within the designated takeoff/landing area. Transition to manual control is permitted for landing. Extra credit and a cash award will be provided for autonomous landing. Control in landing will be graded. Mission completion is when the air vehicle motion ceases, engine is shutdown, and the mission data sheet and imagery have been provided to the judges.

3.5.5 Total Mission Time - Total mission time is the time from declaration of mission start from the judges and permission to turn on transmitters until the vehicle has safely landed, transmitters are shut off, and mission data sheet (or spread sheet) is handed to the judges. Accuracy of results and time required to submit results will be measured. Missions completed between 20 and 40 minutes will receive some bonus points for each minute less than 40 minutes (must land vehicle, crashed and/or terminations do not earn bonus points); however, no additional points will be awarded for mission times less than 20 minutes. Significant points will be deducted for each minute over 40 minutes mission time, up to 60 minutes total where it is mandatory to turn in results. It should also be noted that each team will be given 40 minutes time to set up equipment prior to the beginning of the mission. After 40 minutes, the judges may declare mission start, regardless of the team’s readiness to launch the mission.

3.5.6 Actionable intelligence. Extra credit will be given for providing complete and accurate information (actionable intelligence) during flight: once that information is provided, it cannot be modified later. Actionable intelligence is all six target characteristics (shape, background color, alphanumeric, alphanumeric color, orientation, and location) provided at that time and recorded on the target data sheet. This will not be considered to be actionable intelligence unless designated as such. Credit for actionable intelligence will only be given for one target.

4.0 General Requirements

Key Performance Parameters

Parameter	Threshold	Objective
Autonomy	During way point navigation and area search.	All phases of flight, including takeoff and landing
Imagery	Identify any two target characteristics (shape, background color, orientation, alphanumeric, and alphanumeric color)	Identify all five target characteristics
Target Location	Determine target location ddd.mm.ssss within 250 ft	Determine target location within 50 ft
Mission time ⁽¹⁾	Less than 40 minutes total Imagery/location/identification provided at mission conclusion	20 minutes Imagery/location/identification provided in real time
Operational Availability (A ₀)	Complete 50% of missions within original tasking window (no more than one time out) ⁽²⁾	Complete 100% of missions within original tasking window (no time outs used)
In-flight re-tasking	Add a fly to way point	Adjust search area

Note 1: Time is measured from judges permitting activation of transmitters to the aircraft being shut down and providing the judges the completed mission report & associated imagery. Note that there is a separate requirement for 40 min set up time.

*Note2: **Due to limited competition time, time outs may not be possible and teams that cannot complete their mission within the original tasking window may not be given another mission window. No team will receive more than two opportunities to fly (one time out)***

Key Performance Parameters are the most important requirements. KPPs make up the vast majority of the scoring possible for the mission performance portion of the competition. Failure to meet any threshold will be heavily penalized. Performance beyond the threshold up to the objective will receive some bonus points.

“Shall” indicates a requirement that is mandatory. Failure to meet this requirement will result in no points being awarded in this area.

“May” indicates a permissible implementation, but is not a requirement

“Will” indicates actions to be taken by the competition judges or other information pertaining to the conduct of the competition.

4.1 Safety. Flight operations of any type involve some level of risk to personnel and property. It is the responsibility all personnel involved in 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.

4.1.1 The Maximum takeoff gross weight of the air vehicle shall be less than 55 lbs.

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

4.1.3 The air vehicle shall be capable of manual override by the safety pilot during any phase of flight.

4.1.4 The air vehicle shall automatically return home or terminate flight after loss of transmit signal of more than 30 sec.

4.1.5 The air vehicle shall automatically terminate flight after loss of signal of more than 3 minutes.

4.1.6 The return home system, if installed, shall be capable of activation by the safety pilot.

4.1.7 The flight termination system shall be capable of activation by the safety pilot.

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

- 4.1.8.1 Throttle closed
- 4.1.8.2 Full up elevator
- 4.1.8.3 Full right rudder
- 4.1.8.4 Full right (or left) aileron
- 4.1.8.5 Full Flaps down (if so equipped)
- 4.1.8.6 For other than fixed-wing air vehicles, 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.

4.1.9 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.

4.1.10 The maximum airspeed of the air vehicle shall not exceed 100 KIAS.

4.1.11 Batteries used in the air vehicle shall contain bright colors to facilitate locating them in the event of a crash.

4.1.12 All vehicles will undergo a safety inspection by designated competition safety inspectors prior to being allowed to make any competition or non-competition (i.e. practice) flight. All decisions of the safety inspector(s) are final. Safety inspections will include a physical inspection, fail-safe check, and flight termination check.

4.1.13 Physical inspection of vehicle to insure structural integrity, including:

4.1.13.1 Verify all components adequately secured to vehicle. Verify all fasteners tight and have either safety wire, locktite (fluid) or nylock nuts.

4.1.13.2 Verify propeller structural and attachment integrity.

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

4.1.13.4 Radio range checks, motor off and motor on.

4.1.13.5 Verify all controls move in the proper sense.

4.1.13.6 Check general integrity of the payload system.

4.1.13.7 Verification of AMA Fail-safe mode operation covered by manual override and pilot commanded flight termination.

4.1.14 Officials will disqualify any entry that they deem to pose an unreasonable safety hazard.

4.1.15 Officials will confer with representatives of the host facility, and any entries that, in the opinions of the officials or of the representatives of the host facilities, pose an unreasonable risk to the integrity of the host facility will be disqualified. Seafarer Chapter of AUVSI and the host organization, their employees and agents, as well as the organizing committee, are in no way liable for any injury or damage caused by any entry, or by the disqualification of an entry.

4.1.16 Takeoff shall not be from moving vehicles.

4.1.17 Launchers will be inspected by competition safety inspectors before they are allowed for use in the competition.

4.1.18 At least 25% of the upper, lower, and each side surface of the vehicle shall be a bright color to facilitate visibility in the air and in the event of a crash.

4.1.19 The system shall not exceed more than one motor vehicle and one trailer at the launch site.

4.1.20 No more than ten team members, one advisor and one pilot will be allowed at the mission area.

4.1.21 Exotic, unusual fuels/batteries or components shall not be used. All designs

and systems will undergo a rigorous safety inspection before being permitted to proceed. Any fuel/battery combination deemed high risk in the opinion of judges will be disqualified.

4.2 Air Vehicle

4.2.1 The system shall be limited to one air vehicle in the air at any time.

4.2.2 The system shall not employ any ground based sensors.

4.2.3 The system shall be capable of commanded altitude changes.

4.2.5 The air vehicle shall be capable of heavier than air flight.

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

4.2.7 Aircraft shall comply with the 2007 Official Academy of Model Aeronautics (AMA) National Model Aircraft Safety Code except as noted below

4.2.7.1 Autonomous operation is authorized.

4.2.7.2 Aircraft take-off gross weight shall be less than 55lb.

4.2.7.3 GENERAL - (experimental aircraft rules do not apply)

4.2.7.4 RADIO CONTROL - (combat does not apply and organized racing event does not apply)

4.2.7.5 FREE FLIGHT - does not apply

4.2.7.6 CONTROL LINE - does not apply

4.2.7.7 GAS TURBINE restriction does not apply

4.2.7.8 GIANT SCALE RATING - does not apply

4.3 Environmental. If conditions fall outside environmental requirements or if the judges feel environmental conditions are unsafe (such as approaching thunderstorms), the competition will be suspended. Teams are expected to be able to compete within the required environmental conditions.

4.3.1 The air vehicle shall be capable of takeoff and landing in crosswinds to the runway of 8 kts with gusts to 11 kts.

4.3.2 The system shall be capable of completing mission objectives in temperatures up to 110 deg F at the surface.

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

4.4 Ground Control.

4.4.1 The system should be able to automatically detect/cue targets with a false alarm rate that does not exceed the detection rate. (note: the credit for this requirement will

only be given is three or more targets are automatically detected).

4.4.2 The system should be able to provide imagery and actionable intelligence in real time.

4.4.3 The ground control system displays shall be readable in bright sunlight conditions.

4.4.4 The system shall display “no fly zones” to the operators and judges.

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

4.4.6 The system shall display current air vehicle position with respect to the “no fly zones” to the operator and judges.

Note, failure to meet this requirement will result in disapproval to fly in the competition

4.4.7 The system shall display altitude (MSL) to the judges and operator.

4.4.8 The system shall display indicated airspeed to the judges and operator.

4.4.9 The system should output target data (location (ddd.mm.ssss) & characteristics) in a format provided in attachment 2.

4.4.9.1 Each identified target on the spreadsheet should contain an embedded link to the associate image in a jpeg format.

4.4.9.2 The ground control system should be able to output this target data USB memory stick format.

Note: hardcopy backup is highly encouraged.

4.4.10 The system should have the capability to adjust mission search areas in flight. If the system has the capability to change mission search areas in flight, the new boundaries should be displayed to the operator.

4.5 Imagery

4.5.1 The UAS shall capture target images that can be displayed to the judges. The images may be provided to the judges during the conduct of the mission or when handing in the mission report sheet.

4.5.2 The system should have the capability to capture imagery for up to 60 deg in all directions from vertically below the air vehicle.

4.5.3 Images should be provided to the judges in jpeg format.

4.6 Mission

4.6.1 During the entire mission, air vehicles shall remain in controlled flight and within the no-fly boundary. A specific no-fly boundary definition and diagram will be provided. Any vehicle appearing uncontrolled or moving beyond the no-fly boundary shall be subject to immediate manual override. Failure of manual override will result in flight termination. Points will be deducted for flying in no-fly zones or over flight of the crowd area.

4.6.2 After takeoff, the air vehicles shall attain and remain in flight at an altitude between 100 and 750 ft MSL for the duration of the mission. Decent below 100 ft MSL (except in the recovery area) or above 750 ft MSL shall require manual override. Failure of manual override will result in flight termination. Points will be deducted for flying above or below these altitude limits

4.6.3 Once in autonomous flight the vehicle shall operate with no direct pilot control to flight controls or power. The sensor payload may be manually controlled while under autonomous flight, the team will be directed to provide in-flight mission update to the vehicle.

4.6.4 Transportability. The system shall be transported from the staging area to the mission site within 10 minutes of notification and availability of competition provided transportation (if requested).

4.6.5 The system shall be disassembled and transported off of the designated mission site within 20 minutes from the end of the mission.

4.6.6 The mission will end as previously defined, or when any of the following occur:

4.6.6.1 The judges order the end of the mission.

4.6.6.2 The team captain requests the end of the mission.

4.6.7 Advisors may operate as safety/RC pilots and may communicate to the team in the safety pilot role. Advisors shall not coach the team on nonsafety/RC aspects of the conduct of the mission.

5.0 Place of Performance

5.1 Contestant Facilities. Competitor must identify the facilities they used for system integration and flight test and include the information in with the proof of flight video or statement.

5.2 Government Facilities. The Seafarer Chapter of AUVSI SUAS Competition flight phase will be conducted aboard NAS Patuxent River, MD Webster Field Annex.

5.2.1 All personnel attending the SUAS Competition must be cleared for access to Webster Field. For team members, faculty, or guests that are United States citizens, the following information must be submitted to Jim Curry at

james.curry@bowheadsupport.com or by fax to him at 301 866 1971 by 2 May 2011: Name, Date of Birth, Place of Birth, and Social Security Number. For International Teams or U.S. Teams with foreign nationals (non-U.S. Citizens) a letter on College or University letterhead and signed by a school official must be submitted by 2 May 2011. A sample of the letter to be submitted, data requirements, and forwarding instructions will be sent to team contacts in February 2011. International Teams must begin the process early to obtain passports and visas so that the required data can be submitted to gain access to Webster Field and to obtain the visas to allow international travel. In past competitions some teams have not been able to travel because they delayed in obtaining passports and visas. If teams require letters of invitation to the competition, a request for a letter should be made to Jim Curry. All foreign nationals and those U.S. citizens who were born outside the U.S must submit a copy of either a passport, visa, or naturalization certificate.

6.0 Performance Metrics

6.1 The major graded items/events are:

- 6.1.1 Final Journal Paper
- 6.1.2 Oral Presentation
- 6.1.3 Flight Demonstration

6.2 Each item/event will be measured in four respects:

6.2.1 Autonomy. – The degree to which the system can operate without human intervention will be evaluated as part of the judges’ discretionary score.

6.2.2 Systems Engineering. A methodical approach to deriving performance requirements, allocating functionality to subsystems, system design, adjustments made due to test & evaluation.

6.2.3 Mission Accomplishment. The ability to meet the top-level system requirements that enable mission accomplishment.

6.2.4 Safety. A system safety approach that identifies risk to mission performance, material safety and personnel safety, then implements mitigation strategies to reduce those risks.

SECTION I COMPETITION CLAUSES

1.0 PROOF OF FLIGHT. Based on experience from the 2005 competition, we now require validation that team air vehicles have flown prior to arrival at Webster Field. A video that shows your air vehicle in flight or a statement signed by a faculty member of your university or school that verifies your system has successfully flown at least once shall be submitted with the journal paper. The proof of flight video or statement will identify the facility (or facilities) used for system integration and flight test.

2.0 OFFICIAL RULES, SUBMISSIONS, AND FEES

2.1 The official source for all information concerning rules, interpretations, and information updates for the Seafarer Chapter of AUVSI 2011 Student UAS Competition is the World Wide Web home page at: <http://www.auvsi.org> or <http://www.auvsi-seafarer.org>.

2.2 An Application form is available on the website. A completed form with entry fee is due to AUVSI Seafarer Chapter no later than January 7, 2011.

2.3 The submission shall be in English and is not considered official until the entry fee of five hundred U.S. dollars (\$500 Check or Money Order) has been received by AUVSI Seafarer Chapter. As the competition format cannot handle an unlimited number of entries, the organizers reserve the right to limit the total number of entries that are allowed to compete by declaring the competition closed to new entries before the due date above. Flight Competition/Mission phase may be further limited based upon results of journal paper, static display/oral brief and safety inspection. As with all official information, this announcement (should it be necessary) will appear on the official website.

2.4 Full-time undergraduate or high school students including no more than one graduate student shall compose the team. If a faculty advisor, non-student or AUVSI Staff is used as the air vehicle pilot they are not counted as team members. Members from industry, government agencies, or universities (in the case of faculty or additional graduate students) may advise the team; however, they may not directly contribute in the creation of the design, test, paper or presentation. 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 discussed in Section C, paragraph 5.2.1. No more than ten people from each school will be covered by competition expenses (food, shirts, etc.). Faculty/advisors cannot do anything but be the safety pilot during the competition. Students shall present data analysis, etc. Participants shall be enrolled at their schools for at least 12 credit hours or more per quarter/semester during winter 2010 and/or spring 2011 to be considered "students" unless cleared by the Competition Director (Winter 2010/ Spring 2011 graduating seniors are not considered as grad students for this competition).

2.5 The student members of a joint team shall make significant contributions to the development of their entry. Only the student component of each team is eligible for the cash awards. One student member of the team shall be designated as the "team captain." Only the team captain will speak for the team during the competition run. 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.

3.0 TIMELINE:

The 2011 competition will be a simplified model of the US Department of Defense system acquisition process. The competition rules will simulate a Performance Specification and Statement of Objectives. These will initially be released as a Request for Information (RFI). What this means is that this is a draft of the final specification & rules. Potential competitors are invited to provide comments or questions by 1 November 2010. This will be followed by a virtual "University Day" (modeled after industry day). This will consist of a phone conference that all competitors can dial into to hear directly from the judges and to ask questions. The competition rules will then be modified based on the feedback and put out in its final form that simulates a Request for Proposal. It is the intent of the judges to keep these requirements stable for the rest of the competition, but we reserve the right to make changes we deem necessary.

Date	Item
October 19, 2010	Draft Request for Proposals Released (Competition rules simulating a performance specification and statement of objectives).
November 1, 2010	Deadline for comments or questions
November 4, 2010	University Day (3:00 PM, EDT, phone conference with competition judges. See directions on the front page link on how to dial in to the conference.
November 17, 2010	Request for Proposal Released (Final competition rules).
January 7, 2011	Completed entry form and registration fee received by AUVSI Seafarer Chapter.
May 2, 2011	Fact Sheet received by AUVSI Seafarer Chapter. Team information (Section C, paragraph 5.2.1) & graduate student statement due.
May 23, 2011	Journal paper received by AUVSI Seafarer Chapter (including proof of flight video or statement)
June 15-19, 2011	2011 Undergraduate Students Unmanned Aerial Systems Competition

SECTION J LIST OF ATTACHMENTS

- Attachment 1 Flight Readiness Review Criteria
- Attachment 2 Electronic Data Format

SECTION L INSTRUCTIONS, CONDITIONS, AND NOTICES TO COMPETITORS

1.0 GENERAL

1.1 Format: In order to maximize efficiency and minimize the time for proposal evaluation, it is required that all competitors submit their proposal in accordance with the format and content specified. The electronic proposal shall be prepared so that if an evaluator prints the proposal, it meets the following format requirements.

- 1.1.1 8.5 x 11 inch paper
- 1.1.2 Single-spaced typed lines
- 1.1.3 Not less than 1 inch margins
- 1.1.4 Not smaller than 10-point Times New Roman font in text
- 1.1.5 Electronic submission in pdf format is desired but not required.
- 1.1.6 Each page of the journal shall have the team name and page number in the footer

2.0 COMPETITOR INFORMATION:

2.1 Cover Letter. Identify at a minimum the Competitor Team Name, University affiliation, and abstract of proposal including basic descriptions of the air vehicle and systems. The description shall include frequencies used for air vehicle control (manual or autonomous), payload control, imagery receipt, type of fuel, battery type, and air vehicle dimensions including gross weight. This letter does not count towards the page count.

3.0 TECHNICAL:

Note: Do not reiterate the SOW tasks descriptions as that is ineffective in supporting the competitor's proposal.

3.1 Journal Paper – Shall consist of no more than 20 pages total. Pages beyond 20 pages will not be judged.

3.2 Oral Presentation. (Flight Readiness Review - FRR). Typical FRR criteria are described in attachment 1. The Oral Presentation (FRR) will be reviewed by a panel of AUVSI Seafarer Chapter judges and will be conducted in an open-air environment, with only minimal overhead protection from sun light and/or rain. All team members present should participate.

- 3.2.1 The Oral Presentation (FRR) should follow a simple outline:
 - 3.2.1.1 Team Coordination. Briefly review team members' experience, effectiveness of coordination.
 - 3.2.1.2 System Safety Overview. Review identified risks; avoidance, mitigation strategies.

3.2.1.3 Results of developmental test (DT). Discuss test planning, what tests were performed, the results, any corrective actions taken, impact they had on system implementation. This scope can include sub-system and system level simulation and testing performed during bench, laboratory, ground and flight test efforts to acquire test data and evaluate performance of: components or subsystems, air vehicle integration, ground control system integration, full UAS integration, and mission performance.

3.2.1.4 Evidence of likely Mission Accomplishment. Review demonstrated performance based upon either system or subsystem level development tests that supports successful mission accomplishment during the flight demonstration.

3.2.1.5 Pre-Mission Brief.

3.2.2 Duration. The Oral Presentation (FRR) shall be limited to no more than 15 minutes, plus a 5 minute period for the judges to ask question of the team presenters.

3.2.3 Static Display. Upon completion of the Oral Presentation (FRR) question and answer period, the judges will be provided a brief 5 minute review and inspection of the team's AUS, including air vehicle exterior (and interior if available), ground station, safety check lists, and other supporting evidence of readiness.

3.3 Flight Demonstration. Each team will arrive prepared to begin flight operations. The team will be called forward, set-up at the flight line during their preparation time, then commence start procedures once their demonstration time begins. Flight demonstrations should follow procedures briefed the day before during FRR.

SECTION M EVALUATION FACTORS FOR AWARD

1.0 GENERAL

1.1 The major graded items/events are:

- 1.1.1 Journal Paper
- 1.1.2 Oral Presentation (FRR)
- 1.1.3 Flight Operations :

Note: The Flight operation is most important and the Journal Paper is equal to the Oral Presentation.

2.0 COMPETITOR INFORMATION

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

3.0 BASIS FOR AWARD

- 3.1 Journal Paper
- 3.2 Oral Presentation (FRR)
- 3.3 Flight Operations

3.3.1 Judges will award points for meeting threshold and objectives as outlined in Section C

3.3.2 Judges may award cash barrels for these (or other) requirements (**subject to change, based on sponsorship funding**):

3.3.2.1 Any team that achieve flight will receive a \$TBD cash prize

3.3.2.2 \$TBD cash prize for any team that conducts the waypoint navigation and area search phases of the mission autonomously (KPP threshold, autonomy).

3.3.2.3 Any team that achieves the following "stretch" objectives will either receive a \$TBD cash prize or share \$TBD with the other teams that achieve that objective, whichever is less.

3.3.2.3.1 Autonomous takeoff (KPP objective, autonomy).

3.3.2.3.2 Autonomous landing (KPP objective, autonomy).

3.3.2.3.3 Obtain an image and correctly identify 4 of 5 parameters for the "off flight path" in-route target (para 3.5.2.2 & 4.5.2).

3.3.2.3.4 Obtain an image, correctly identify, and provide the location within 250 ft of the "pop-up" target during the area search phase. (para 3.5.3).

3.3.2.3.5 Successfully perform automatic target identification or cueing on at least two targets in the search area with the number of false detections being no greater than the number of correct detections (para 4.4.1).

3.3.2.3.6 Identify a target (2 characteristics) within 50 ft (KPP objective, target location)

3.3.2.3.7 Identify (2 characteristics, within 250 ft) all targets (KPP imagery) within the primary search area.

3.3.2.3.8 Provide all target data in electronic format for at least 2 targets, including image (objectives, paragraphs 4.4.9.1 & 4.4.9.2)

3.3.2.3.9 Provide actionable intelligence on one target (Paras 3.5.5 & 4.4.2)

3.3.2.3.10 Complete a mission identifying at least 50% of the targets in the primary search area with no time outs (KPP $A_o = 100\%$) within 20 minutes (KPP objective, mission time).

3.3.3 An award will be given to the best overall safety approach/execution

3.4 Overall award for the best combined score from Journal, Presentation (FRR), and Flight Operations.

Attachment 1 Flight Readiness Review

The FRR is a multi-disciplined technical review to ensure that the subsystem or system under review is ready to proceed into formal test. The FRR assesses test objectives, test methods and procedures, scope of tests, and safety. The FRR verifies the traceability of planned tests to program requirements and user needs. The FRR determines the completeness of test procedures. The FRR assesses the system under review for development maturity, effectiveness, and risk to determine readiness to proceed to flight testing.

The FRR should answer the following questions:

- Will the planned flight test verify all directly traceable requirements?
- Is the configuration of the system under test sufficiently mature, defined, and representative to accomplish planned test objectives and or support defined program objectives?
- Have all planned preliminary, informal, functional, unit level, subsystem, system, and qualification tests been conducted, and are the results satisfactory?
- Have all applicable flight/system limitations been defined and agreed to?
- Is the planned test properly resourced (people, test article or articles, facilities, data systems, support equipment, logistics, etc.)?
- Have the crew members been trained properly?
- Has a discrepancy identification and reporting system been defined and agreed to?
- Have Go/No-Go criteria been agreed to?
- What is the fall-back plan should a technical issue or potential showstopper arise during testing?
- Has a final reporting process been defined and agreed to?
- What is the expected result and how can/do the test results affect the program?
- What are the risks associated with the tests and how are they being mitigated?

FRR success criteria:

- A. Identified risk level is acceptable.
- B. The judgment that previous component, subsystem, and system test results form a satisfactory basis for proceeding into planned tests.

Test and evaluation is critical to evaluating the system. The FRR ensures that the testing to be conducted properly evaluates the system and that the system is ready to be tested.

Attachment 2 Electronic Data Format

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

8 fields, tab delimited, new target on each line

Field 1: Target Number, two digits, starting at 01 and increment by one for each additional target.

Example: 01, 02, 03, etc.

Field 2: 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

Field 3: 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

Field 4: Target orientation, up to two characters: N, NE, E, SE, S, SW, W, NW

Field 5 Target shape, list geometric shape as appropriate:

Example, rectangle, square, isosceles triangle

Field 6: Target color, as appropriate.

Example: Red, Orange, Yellow, etc.

Field 7: Alphanumeric, as appropriate

Example: A, b, 2, &

Field 8: Alphanumeric color, as appropriate

Example: Red, Orange, Yellow, etc.

Example for two targets

01	N30 35 34.123	W075 48 47.123	N	rectangle	red	A
	orange					
02	S34 00 12.345	E002 01 12.345	SE	square	orange	4
	yellow					