

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

CERTIFICATE OF WAIVER OR AUTHORIZATION

ISSUED TO

Middle Tennessee State University

1301 East Main Street

Murfreesboro, TN 37132

This certificate is issued for the operations specifically described hereinafter. No person shall conduct any operation pursuant to the authority of this certificate except in accordance with the standard and special provisions contained in this certificate, and such other requirements of the Federal Aviation Regulations not specifically waived by this certificate.

OPERATIONS AUTHORIZED

Operation of the Aerosonde Mark 4.7 Unmanned Aircraft System (UAS) in Class E and G airspace at or below 4,000' Above Ground Level at the ISR Group Range Complex in Hardin County, TN under the jurisdiction of the Memphis Air Route Traffic Control Center (ZME ARTCC).

LIST OF WAIVED REGULATIONS BY SECTION AND TITLE

N/A

STANDARD PROVISIONS

1. A copy of the application made for this certificate shall be attached and become a part hereof.
2. This certificate shall be presented for inspection upon the request of any authorized representative of the Federal Aviation Administration, or of any State or municipal official charged with the duty of enforcing local laws or regulations.
3. The holder of this certificate shall be responsible for the strict observance of the terms and provisions contained herein.
4. This certificate is nontransferable.

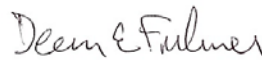
Note-This certificate constitutes a waiver of those Federal rules or regulations specifically referred to above. It does not constitute a waiver of any State law or local ordinance.

SPECIAL PROVISIONS

Special Provisions are set forth and attached.

This certificate 2011-ESA-27 is effective from July 1, 2011 to June 30, 2012, and is subject to cancellation at any time upon notice by the Administrator or his/her authorized representative.

BY DIRECTION OF THE ADMINISTRATOR



FAA Headquarters, AJV-13
(Region)

Dean E. Fulmer
(Signature)

July 1, 2011
(Date)

Acting Manager, Unmanned Aircraft Systems
(Title)

ATTACHMENT to FAA FORM 7711-1

Issued To: Middle Tennessee State University

Address: 1301 East Main Street
Murfreesboro, TN 37132

Activity: Operation of the Aerosonde Mark 4.7 Unmanned Aircraft System (UAS) in Class E and G airspace at or below 4,000' Above Ground Level at the ISR Group Range Complex in Hardin County, TN under the jurisdiction of the Memphis Air Route Traffic Control Center (ZME ARTCC).

Purpose: To prescribe UAS operating requirements (outside of restricted and/or warning area airspace) in the National Airspace System (NAS) for the purpose of training and/or operational flights.

Dates of Use: This Certificate of Authorization (COA) 2011-ESA-27 is valid from July 1, 2011 through June 30, 2012. Should a renewal become necessary, the proponent shall advise the Federal Aviation Administration (FAA), in writing, no later than 60 days prior to the requested effective date.

General Provisions:

- The review of this activity is based on our current understanding of UAS operations, and the impact of such operations in the NAS, and therefore should not be considered a precedent for future operations. As changes occur in the UAS industry, or in our understanding of it, there may be changes to the limitations and conditions for similar operations.
- All personnel connected with the UAS operation must comply with the contents of this authorization and its provisions.
- This COA will be reviewed and amended as necessary to conform to changing UAS policy and guidance.

Safety Provisions:

Unmanned Aircraft (UA) have no on-board pilot to perform see-and-avoid responsibilities, and therefore, when operating outside of restricted areas, special provisions must be made to ensure an equivalent level of safety exists for operations had a pilot been on board. In accordance with 14 CFR Part 91, General Operating and Flight Rules, Subpart J-Waivers, 91.903, Policy and Procedures, the following provisions provide acceptable mitigation of 14 CFR Part 91.111/113 and must be complied with:

- For the purpose of see-and-avoid, visual observers must be utilized at all times except in Class A airspace, restricted areas, and warning areas. The observers may either be ground based or in a chase plane. If the chase aircraft is operating more

than 100ft above/below and or ½ nm laterally, of the UA, the chase aircraft PIC will advise the controlling ATC facility.

- In order to comply with the see and avoid requirements of Title 14 of the Code of Federal Regulations sections 91.111 and 91.113, the pilot-in-command and visual observers must be able to see the aircraft and the surrounding airspace throughout the entire flight; and be able to determine the aircraft's altitude, flight path and proximity to traffic and other hazards (terrain, weather, structures) sufficiently to exercise effective control of the aircraft to give right-of-way to other aircraft, and to prevent the aircraft from creating a collision hazard.
- UAS pilots will ensure there is a safe operating distance between manned and unmanned aircraft at all times in accordance with 14 CFR 91.111, *Operating Near Other Aircraft*, and 14 CFR 91.113, *Right-of-Way Rules*. Cloud clearances and VFR visibilities for Class E airspace will be used regardless of class of airspace. Additionally, UAS operations are advised to operate well clear of all known manned aircraft operations.
- The dropping or spraying of aircraft stores, or carrying of hazardous materials (included ordnance) outside of active Restricted, Prohibited, or Warning Areas is prohibited unless specifically authorized in the Special Provisions of this COA.

Airworthiness Certification Provisions:

- UA must be shown to be airworthy to conduct flight operations in the NAS.
- Public Use Aircraft must contain one of the following:
 - o A civil airworthiness certification from the FAA, or
 - o A statement specifying that the Department of Defense Handbook "Airworthiness Certification Criteria" (MIL-HDBK-516), as amended, was used to certify the aircraft or
 - o Equivalent method of certification.

Pilot / Observer Provisions:

- **Pilot Qualifications:** UA pilots interacting with Air Traffic Control (ATC) shall have sufficient expertise to perform that task readily. Pilots must have an understanding of and comply with Federal Aviation Regulations and Military Regulations applicable to the airspace where the UA will operate. Pilots must have in their possession a current second class (or higher) airman medical certificate that has been issued under 14 CFR 67, Medical Standards and Certification, or a military equivalent. 14 CFR 91.17, Alcohol or Drugs, applies to UA pilots.
- Aircraft and Operations Requirements:
 - o Flight Below 18,000 Feet Mean Sea Level (MSL).
 - UA operations below 18,000 feet MSL in any airspace generally accessible to aircraft flying in accordance with visual flight rules (VFR) require visual observers, either airborne or ground-based. Use of ATC radar alone does not constitute sufficient collision risk mitigation in airspace where uncooperative airborne operations may be conducted.

- o Flights At or Above 18,000 Feet Mean Sea Level (MSL)
 - When operating on an instrument ATC clearance, the UA pilot-in-command must ensure the following:
 1. An ATC clearance has been filed, obtained and followed.
 2. Positional information shall be provided in reference to established NAS fixes, NAVAIDS, and waypoints. Use of Latitude/Longitude is not authorized.
- **Observer Qualifications:** Observers must have been provided with sufficient training to communicate clearly to the pilot any turning instructions required to stay clear of conflicting traffic. Observers will receive training on rules and responsibilities described in 14 CFR 91.111, *Operating Near Other Aircraft*, 14 CFR 91.113, *Right-of-Way Rules*, cloud clearance, in-flight visibility, and the pilot controller glossary including standard ATC phraseology and communication. Observers must have in their possession a current second class (or higher) airman medical certificate that has been issued under 14 CFR 67, Medical Standards and Certification, or a military equivalent. 14 CFR 91.17, Alcohol or Drugs, applies to UA observers.
- **Pilot-in-Command (PIC) –**
 - o **Visual Flight Rules (VFR) as applicable:**
 - The PIC is the person directly responsible for the operation of the UA. The responsibility and authority of the pilot in command as described by 14 CFR 91.3 (or military equivalent), applies to the UAS PIC.
 - The PIC operating a UA in line of sight must pass at a minimum the required knowledge test for a private pilot certificate, or military equivalent, as stated in 14 CFR 61.105, and must keep their aeronautical knowledge up to date.
 - There is no intent to suggest that there is any requirement for the UAS PIC to be qualified as a crewmember of a manned aircraft.
 - Pilots flying a UA on other than instrument flight plans beyond line of sight of the PIC must possess a minimum of a current private pilot certificate, or military equivalent in the category and class, as stated in 14 CFR 61.105.
 - o **Instrument Flight Rules (IFR) as applicable:**
 - The PIC is the person directly responsible for the operation of the UA. The responsibility and authority of the pilot in command as described by 14 CFR 91.3 (or military equivalent), applies to the UAS PIC.
 - The PIC must be a certified pilot (minimum of private pilot) of manned aircraft (FAA or military equivalent) in category and class of aircraft flown.
 - The PIC must also have a current/appropriate instrument rating (manned aircraft, FAA or military equivalent) for the category and class of aircraft flown.
- **Pilot Proficiency – VFR/IFR as applicable:**
 - o Pilots will not act as a VFR/ IFR PIC unless they have had three qualified proficiency events within the preceding 90 days.

- The term “qualified proficiency event” is a UAS-specific term necessary due to the diversity of UAS types and control systems.
- A qualified proficiency event is an event requiring the pilot to exercise the training and skills unique to the UAS in which proficiency is maintained.
- o Pilots will not act as an IFR PIC unless they have had six instrument qualifying events in the preceding six calendar months (an event that requires the PIC to exercise instrument flight skills unique to the UAS).
- **PIC Responsibilities:**
 - o Pilots are responsible for a thorough preflight inspection of the UAS. Flight operations will not be undertaken unless the UAS is airworthy. The airworthiness provisions of 14 CFR 91.7, Civil Aircraft Airworthiness, or the military equivalent, apply.
 - o One PIC must be designated at all times and is responsible for the safety of the UA and persons and property along the UA flight path.
 - o The UAS pilot will be held accountable for controlling their aircraft to the same standards as the pilot of a manned aircraft. The provisions of 14 CFR 91.13, *Careless and Reckless Operation*, apply to UAS pilots.
- **Pilot/Observer Task Limitations:**
 - o Pilots and observers must not perform crew duties for more than one UA at a time.
 - o Chase aircraft pilots must not concurrently perform either observer or UA pilot duties along with chase pilot duties.
 - o Pilots are not allowed to perform concurrent duties both as pilot and observer.
 - o Observers are not allowed to perform concurrent duties both as pilot and observer.

Standard Provisions: These provisions are applicable to all operations unless indicated otherwise in the Special Provisions section.

- The UA PIC will maintain direct two-way communications with ATC and have the ability to maneuver the UA per their instructions, unless specified otherwise in the Special Provisions section. The PIC shall comply with all ATC instructions and/or clearances.
- If equipped, the UA shall operate with an operational mode 3/A transponder, with altitude encoding, or mode S transponder (preferred) set to an ATC assigned squawk.
- If equipped, the UA shall operate with position/navigation lights on at all times during flight.
- The UA PIC shall not accept any ATC clearance requiring the use of visual separation or sequencing.
- VFR cloud clearances and visibilities for Class E airspace will be used regardless of class of airspace the UAS is operating in, except when operating in Class A airspace where 14 CFR Part 91.155 will apply.
- Special VFR is not authorized.

- Operations (including lost link procedures) shall not be conducted over populated areas, heavily trafficked roads, or an open-air assembly of people.
- Operations outside of restricted areas, warning areas, prohibited areas (designated for aviation use) and/or Class A airspace may only be conducted during daylight hours, unless authorized in the Special Provisions section.
- Operations shall not loiter on Victor airways, Jet Routes, Q Routes, IR Routes, or VR Routes. When necessary, transit of airways and routes shall be conducted as expeditiously as possible.
- Operations conducted under VFR rules shall operate at appropriate VFR altitudes for direction of flight (14 CFR 91.159).
- The UA PIC or chase plane PIC (whichever is applicable) will notify ATC of any in flight emergency or aircraft accident as soon as practical.
- All operators that use GPS as a sole source must check all NOTAMs and Receiver Autonomous Integrity Monitoring (RAIM). Flight into GPS test area or degraded RAIM is prohibited without specific approval in the special provisions.
- At no time will TCAS be used in any mode while operating an unmanned aircraft.
- Only one UA will be flown in the operating area unless indicated otherwise in the Special Provisions.
- A copy of this COA will be maintained on site by the PIC or designated representative.
- Middle Tennessee State University, and/or its representatives, is responsible at all times for collision avoidance with non-participating aircraft and the safety of persons or property on the surface with respect to the UAS.

Special Provisions:

1. In the event of a lost link, the UAS pilot will immediately notify Memphis ARTCC at (901) 368-8106, state pilot intentions, and comply with the following provisions:
 - The aircraft will comply with the Lost Link provisions depicted in Attachment 2 of this document.
 - Lost Link landings will normally occur within the assigned ROZ to avoid traffic in other zones. If a belly landing at the AF ROZ is programmed as a lost link option, the recovery procedure path will deconflict by time, altitude, and waypoint location to avoid other possible UA experiencing lost link concurrently.
 - If lost link occurs within a restricted or warning area, or the lost link procedure above takes the UA into the restricted or warning area – the aircraft will not exit the restricted or warning areas until the link is re-established.
 - The UA lost link mission will not transit or orbit over populated areas.
 - When outside of restricted/warning area airspace, lost link programmed procedures will avoid unexpected turn-around and/or altitude changes and will provide sufficient time to communicate and coordinate with ATC.
 - Lost link orbit points shall not coincide with the centerline of Victor airways.

2. The PIC must have at least a Current FAA private pilot certificate or the FAA accepted agency equivalent, based on the application or 14 CFR Part 61 for any operations above 400' AGL in Class G airspace.
3. Operating area shall be divided into five independent sub-areas in accordance with the graphics in Attachment 1 of this document.
4. Only one UAS can be flown in each sub-area at a time, to include lost-link situations. Each operation and sub-area will be mutually exclusive of the other in all phases of flight. A maximum of one UA will be controlled at a time from each ground control station.
5. Middle Tennessee State University or designated representative shall contact Memphis ARTCC Front Line Manager at (901) 368-8106 one hour prior to the start of UAS operations and immediately after UAS operations are complete. Memphis ARTCC will assign a beacon code for the aircraft.
6. Middle Tennessee State University shall provide a telephone number to Memphis ARTCC where the UAS crew may be reached at all times while UAS flight activities are underway. Adequate cell phone coverage is required if coordination involves cellular telephones.
7. Direct communication with Memphis ARTCC is not required while operating in the Operations Area, however, if a chase aircraft is airborne, the chase pilot will monitor ZME on frequency 124.35.
8. The proponent will submit a flight schedule to Memphis ARTCC, 24 hours in advance of operations via fax at (901) 368-8199.
9. Memphis ARTCC may delay or terminate UAS operations if necessary for the safety of flight.
10. The Aerosonde Mark 4,7 UAS must be operated in strict compliance withal manufacturers' specifications and recommendations as well as provisions contained in the most recent Airworthiness Certification Statement dated April 11, 2011. Any changes to the current Airworthiness Certification Statement will be provided to the AVS Unmanned Aircraft Program Office (AFS-407) for review.
11. The PIC shall not engage in any activity not directly related to flying the aircraft.
12. Sterile cockpit procedures must be observed during all critical phases of flight.
13. The PIC must conduct a pre-takeoff briefing which includes a briefing on the contents of the COA, the maximum altitudes to be flown, initial heading, frequencies to be used, lost link procedures, the parameters for the use of a ditch point, a risk analysis for the flight being flown, emergency procedures,

communications with air traffic control (ATC), frequencies to be monitored for flight operations and a briefing on the expected duration of flight.

14. The use of cell phones or other telephonic communication is restricted to the operational control of the UAS, and any required communications with ATC. Battery powered communication modes shall be charged and tested prior to flight operations.
15. The holder of this COA, or delegated representative, is responsible for halting or canceling activity in the operating area if, at any time, the safety of persons or property on the ground or in the air is in jeopardy, or if there is a failure to comply with the terms or conditions of this waiver.
16. Operations will be conducted only in visual meteorological conditions, Class E minimums apply (see Standard Provisions).
17. Night Operations are prohibited. UAS night operations are those operations that occur between the end of evening civil twilight and the beginning of morning civil twilight, as published in the American Air Almanac, converted to local time. (Note: this is equal to approximately 30 minutes after sunset until 30 minutes before sunrise).
18. Direct communication capability between the UA PIC in each ROZ is required anytime concurrent operations are taking place.
19. Special provisions 1, 5, 6, 7, and 8 will be used in lieu of maintaining direct two-way communications with ATC (Standard Provisions, bullet one).

NOTAM: A distance (D) Notice to Airmen shall be issued when UA operations are being conducted. This requirement may be accomplished through your local base operations or NOTAM issuing authority. You may also complete this requirement by contacting Flight Service Station at 1-877-4-US-NTMS (1-877-487-6867) not more than 72 hours in advance, but not less than 48 hours prior to the operation and provide:

- Name and Address of pilot filing NOTAM request
- Location, Altitude or the operating Area
- Time and nature of the activity

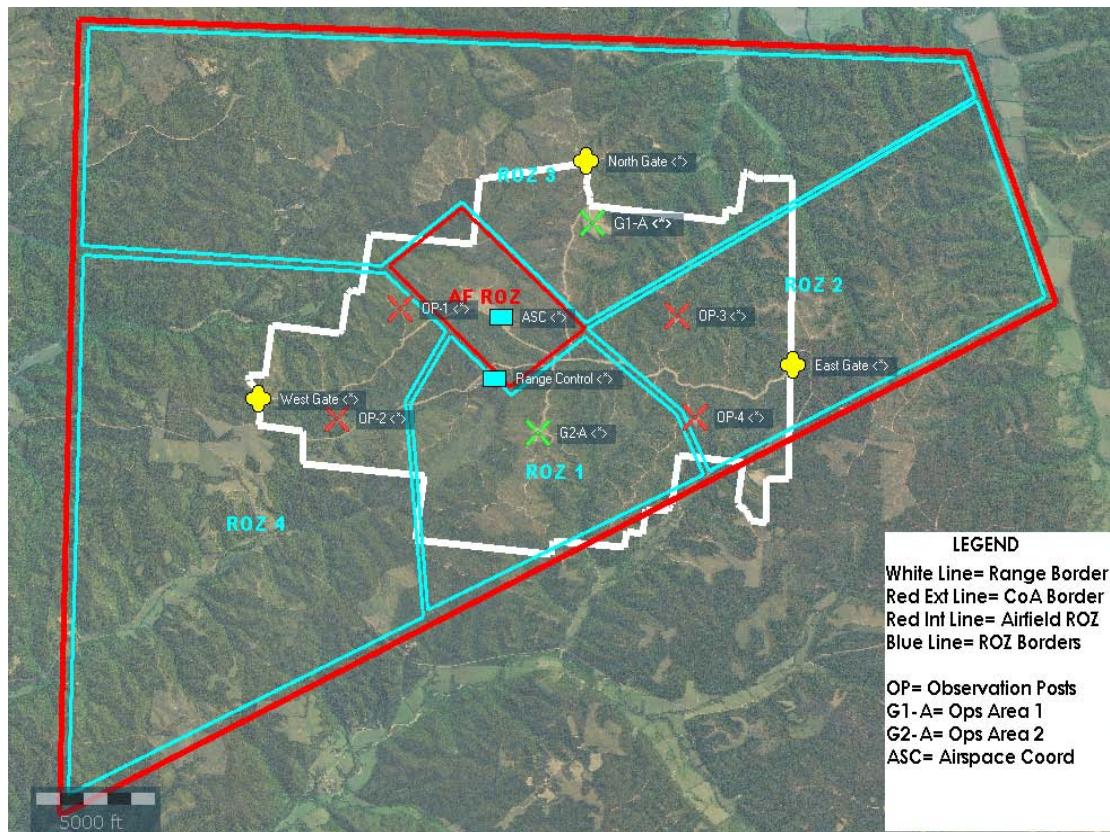
NOTE FOR PROPONENTS FILING THEIR NOTAM WITH DoD ONLY: This requirement to file with the AFSS is in addition to any local procedures/requirements for filing through DINS. The FAA Unmanned Aircraft Systems Office is working with the AFSS, and to eliminate the requirement to file a NOTAM with both the AFSS and DINS in the near future.

Incident / Accident and Normal Reporting Provisions: The following information is required to document routine and unusual occurrences associated with UAS activities in the NAS.

- The proponent for the COA shall provide the following information to Donald.E.Grampp@faa.gov on a monthly basis:
 - o Number of flights conducted under this COA.
 - o Pilot duty time per flight.
 - o Unusual equipment malfunctions (hardware/software).
 - o Deviations from ATC instructions.
 - o Operational/coordination issues.
 - o All periods of loss of link (telemetry, command and/or control)
- The following shall be submitted via COA Online, email or phone (202-385-4542, cell 443-569-1732) to Donald.E.Grampp@faa.gov **within 24 hours and prior to any additional flight under this COA:**
 - o All accidents or incidents involving UAS activities, including lost link.
 - o Deviations from any provision contained in the COA.

This COA does not, in itself, waive any Federal Aviation Regulation (FAR) nor any state law or local ordinance. Should the proposed operation conflict with any state law or local ordinance, or require permission of local authorities or property owners, it is the responsibility of Middle Tennessee State University to resolve the matter. This COA does not authorize flight within Special Use Airspace without approval from the Using Agency. Middle Tennessee State University is hereby authorized to operate the Aerosonde Mark 4.7 Unmanned Aircraft System in the operations area depicted in "Activity" above and attachment 1 below.

Attachment 1
Page 1



Range Area Coordinates

- N 35° 12' 58.11" W 088° 04' 48.03"
- N 35° 12' 43.28" W 087° 57' 35.14"
- N 35° 10' 48.74" W 087° 56' 51.82"
- N 35° 06' 54.08" W 088° 04' 58.47"

ROZ 1 Coordinates

– ROZ 1 :

- 35.16709742, -88.03485730 / 16SDD 05740 92078
- 35.17309378, -88.02666644 / 16SDD 06495 92729
- 35.16855832, -88.02148815 / 16SDD 06953 92208
- 35.17635349, -88.01087265 / 16SDD 07941 93070
- 35.16614875, -88.99904888 / 16SDD 09052 91937
- 35.15841753, -87.99539042 / 16SDD 09328 91079
- 35.14133880, -88.03272842 / 16SDD 05924 89225

ROZ 2 Coordinates

– ROZ 2:

- 35.1836640, -88.01769095 / 16SDD 07321 93891
- 35.19804386, -87.95610408 / 16SDD 12933 95421
- 35.18094085, -87.94932025 / 16SDD 13538 93526
- 35.15901517, -87.99462802 / 16SDD 09415 91142
- 35.16664485, -87.99835845 / 16SDD 09067 92019

ROZ 3 Coordinates

– ROZ 3:

- 35.21495181, -88.07854854/ 16SDD 01862 97443
- 35.18753717, -88.07954922/ 16SDD 01686 94383
- 35.18498978, -88.03901725/ 16SDD 05369 94094
- 35.19306957, -88.02821232/ 16SDD 06393 94956
- 35.18435711, -88.01817713/ 16SDD 07291 93967
- 35.19884022, -87.95640184/ 16SDD 12916 95532
- 35.21080486, -87.96060372/ 16SDD 12573 96835

ROZ 4 Coordinates

– ROZ 4:

- 35.17380243, -88.02735688 / 16SDD 06442 92818
- 35.16786947, -88.03583270 / 16SDD 05650 92185
- 35.13993419, -88.03392711 / 16SDD 05798 89048
- 35.11793277, -88.08129462 / 16SDD 01460 86653
- 35.18634815, -88.07929255 / 16SDD 01720 94275
- 35.18407705, -88.03849021 / 16SDD 05421 93969

Airfield (AF) ROZ Coordinates

– Airfield (AF) ROZ:

- 35.18488149, -88.03799084 / 16SDD 05476 94057
- 35.19228026, -88.02816401 / 16SDD 06375 94885
- 35.17697628, -88.01155309 / 16SDD 07871 93160
- 35.16970208, -88.02151964 / 16SDD 06954 92350

AEROSONDE LOST LINK PROCEDURES

UAS generally have a series of mission parameters which are usually physically loaded into its memory prior to flight. These parameters define the locations of emergency runways, lost link plans, and timing and safety limits used by the aircraft in the event of lost link or lost navigation situations. Although some are configurable in flight, these parameters are typically designed for a given takeoff/launch and recovery site and are configured for the anticipated flight environment missions. If the UAS follows an autonomous lost-uplink procedure if communications from the EGCS fail, ensure that the default actions for altitude changes are noted in all airspace de-confliction efforts prior to operations commencement with Airspace Coordinator. Many elements of the procedure may be configurable. For Aerosonde operations within the ISR Group Range (airspace defined in the approved FAA COA), the aircraft will be programmed to hold at a point within its designated ROZ until communications are reacquired. Each UAS in operation will be given coordinates and default altitudes to a designated ROZ with which to program the UAS to de-conflict with other operations ongoing at the Range. The PIC is able to observe and recognize loss of command link via a GUI that will show the AV communications status to the operator. If link is lost, the "COMM" and "LINK" light will turn red.

Aerosonde Lost-Link Procedure within the ISR Group Range Complex:

1. The lost-link procedure begins after the lost communications timer has elapsed (60 seconds) without the UAS receiving any messages from the ground. The Piccolo autopilot will be pre-programmed to fly its' lost link procedure. Return Home altitude is user selectable based upon mission location and terrain and is included in the mission planning process. The return home flight plan is highly customizable and can include multiple waypoints and multiple altitudes in order to route the aircraft around terrain, other ROZs, or no-fly zones. The aircraft then begins to navigate to the designated lost communications flight plan--center point of its assigned ROZ. The waypoint in the lost communications flight plan the aircraft tracks to is the closest waypoint to the aircraft that is also the closest waypoint to the termination of the plan.

For Aerosonde operations within the ISR Group Range complex, each ROZ will have a center point as its lost link holding waypoint. Aircraft will be assigned a lost link orbit altitude based on the activities within the range. All holding altitudes will be within the parameters of the approved FAA COA. Center points are listed below.

ROZ 1: 35.16388005, -88.01740594 / 16SDD 07344 91691

ROZ 2: 35.18055143, -87.97870999 / 16SDD 10886 93504

ROZ 3: 35.19982293, -88.01924132 / 16SDD 07218 95679

ROZ 4: 35.15607968, -88.05732548 / 16SDD 03699 90864

ER ROZ: 35.18055143, -88.02459452 / 16SDD 06708 93546

2. The PIC notifies ASC (ISR tower) and all observers about the issue and initiates checklist procedures and coordinate actions accordingly.
3. The aircraft will continue to hold in the lost link orbit until communications are re-established or the aircraft's fuel is exhausted, at which point the aircraft will descend at the lost link orbit until contact is made with the ground.
4. Alternatively, the aircraft can be programmed to conduct an autonomous belly landing at the expiration of the flight timer. In this instance, the aircraft continues tracking to and remains within lost link orbit for a specific preprogrammed "flight timer" duration while the PIC is trying to reestablish link. Holding time will be preprogrammed based on the usable fuel load of the aircraft, mission, and other activity within the ISR Range complex. Observers continue aircraft monitoring and sending reports to ASC/PIC of aircraft location and attitude. At the expiration of the flight timer (as long as the appropriate setup procedure has been conducted), the aircraft will depart the lost link orbit and enter an autonomous belly landing flight plan. Location of belly landing will be preprogrammed based on other activity within the ISR Group Range complex – normally the primary site for belly landings will be the Airfield (AF) ROZ.
5. In the event the flight timer and autonomous belly landing is utilized, the PIC calls local Guard Freq's (KSNH: UNICOM 122.8) of landing operations per established launch/recovery communication procedures.
6. Observers monitor aircraft as it completes landing evolution and send reports of positive recovery to ASC/PIC. ASC advises ATC/FSS/Local traffic of completion of recovery ops.

Back-up Communications Links.

The secondary or back-up C2 frequency range is 1350 – 1390 MHz. Secondary command and control links are provided by a data modem with a single antenna attached to the port wing. The output power of the 2C2 radio on the aircraft is 1 watt. The output power of the 2C2 radio on the EGCS is 5 watts.

Return Home Modes.

The Aerosonde has an automatic "return home" feature (also called "reversion mode" or "Preprogrammed Emergency Mission" in some vehicles) in the event of loss of link. The aircraft is programmed prior to launch with a lost link waypoint and altitude based on what other activities are occurring within the ISR Group Range complex. The information is loaded during preflight based upon safety information and other activities provided by the range safety officer. The lost link waypoint can be updated during flight if necessary.

The Aerosonde will execute a "return home" mode if the aircraft losses both primary and secondary C2 with the ground station for more than a specified amount of time. The timeout is typically set to 60 seconds; however this can be modified if requested by range safety. If the aircraft is not already at its assigned lost link altitude, the aircraft will climb to a specified altitude and perform orbits around the lost link holding orbit. The Aerosonde can be pre-programmed with multiple "return home" points if it needs to transit several ROZs within the ISR Group Range complex. A total of 99 waypoints, each with a specific altitude if needed, can be loaded to the aircraft.

Flight Termination Link

There is no flight termination system onboard the aircraft. If necessary the flight can be terminated by shutting of the Engine, if comms exist, or the aircraft will fly to the lost link holding orbit and loiter until running out of gas, if no comms exist. The return home location (lost link holding orbit) is established as part of the standard operator preflight procedure.

GPS vs Dead Reckoning (DR) Navigation Source and "Return Home" Mode.

The Aerosonde will transition into dead reckoning in which the aircraft will rely on an internal navigation system, magnetometer, and GPS. If GPS is not being received or GPS is jammed, the aircraft will continue to track the previously commanded flight plan in dead reckoning. The PIC will utilize the camera to navigate the UA to a safe landing. If during a GPS fail, communications also fail, the autopilot will initiate the 'flight termination sequence' by enabling the dead man circuitry after the GPS (30 Seconds) and Communication (60 Seconds) timers have elapsed. Flight termination for the Aerosonde will simply disable the aircraft ignition, killing the engine. All flight terminations will remain over ISR Group owned property.

In the Event of a *FLY-AWAY* situation:

The PIC will notify ASC (ISR tower) of the emergency event; ASC will in turn notify ZME (by the most expeditious means possible) using the following order:

- ☐ ATC contact VHF 124.35
- ☐ Phone call to Area 6
- ☐ Watch Desk @ (901) 368-8234
- ☐ Will provide the following data:
 - o Last know location
 - o Last known altitude
 - o Last known heading
 - o Fuel on board / BATT life
 - o Intentions