GROUP II SYSTEMS- SCANEAGLE

1. **INTRODUCTION.** This document covers ScanEagle UAS operations at ISR Range Services facilities located in Hardin County, TN. This SOP will be used in conjunction with an approved Airworthiness Release and Federal Aviation Administration (FAA) Certificate of Waiver or Authorization (COA) for operations at ISR Range Services.

   One Pilot in Command (PIC) shall be designated at all times and is responsible for the safety of the Unmanned Aircraft (UA) as well as persons and property along the UA flight path. The PIC shall be a trained, qualified, may hold position of a Vehicle Operator (VO), and shall be held accountable for operation of their aircraft as to the same standards as the pilot of a manned aircraft. The provisions of 14 CFR 91.13, Careless and Reckless Operation, apply to Unmanned Aerial Systems (UAS) pilots.

   UAS operations at ISR Range Services will be conducted in Class E and G airspace (as depicted in figure 1 below), surface up to but not including 4,000 feet AGL. Operations will be conducted a maximum of 6 days a week, and up to 12-hours per day in VMC, between the hours of sunrise to sunset. Visual observers will remain in communication with the PIC and will be positioned so that they remain within 2000' vertically and 1 nautical mile laterally of the UAS during all operations. Chase aircraft will be used when operating more than one mile from Launch/Recovery Site.

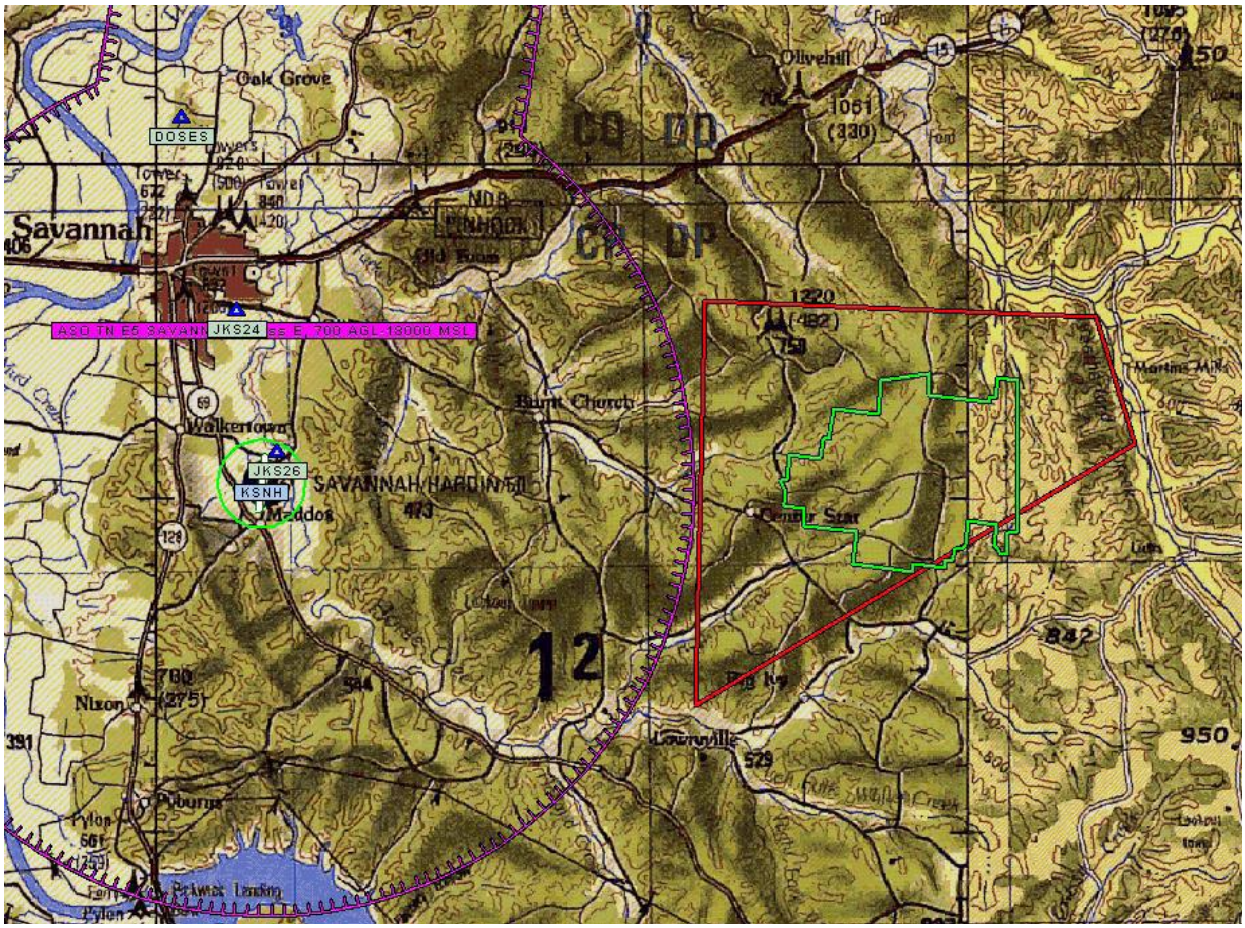

Figure 1: Scan Eagle Operations Area. (Outlined in red; ISR Range Services property boundaries in green.)

2. **TRANSPONDER REQUIREMENTS.** ScanEagle operations will be conducted with a functional transponder with valid altitude reporting capability. If the transponder and/or altitude reporting capability become inoperable while conducting the mission, the PIC shall immediately coordinate with the Memphis Center ARTCC (MEM ARTCC) and advise them of the limitation. MEM ARTCC may direct the recovery of or restrict UAS operations as the situation dictates. USSOCOM personnel shall coordinate with ZME ARTCC to obtain squawk assignment and, ISR Range Services Range Control may assist with this effort.

3. **VISUAL OBSERVER REQUIREMENTS.** Visual Observers performing as either Ground Observers (GO) shall be positioned within 2000' vertically and 1NM laterally of the airborne UAS and provide advisories assisting the VO to avoid other traffic in the vicinity. Aerial Observers (AOs) shall be positioned via chase aircraft within 400' of the airborne UAS and also provide advisories assisting the VO to avoid other traffic in the vicinity. GO's will be used for all local flights in which the aircraft is not intended to fly beyond 1NM of the Ground Control Station (GCS), and AO's will be utilized when flights are expected to go beyond 1NM from the GCS. All Observers will have at least at Class II Airman Medical Certificate and possess knowledge of applicable 14 CFR part 91 guidelines.

4. **FLIGHT SCHEDULING AND NOTAMS.** UAS operations will be scheduled a minimum of 72 hours prior with the ISR Range Services Range Control and coordinated with the ZME ARTCC at XXX/XXX-XXXX, or via email XXX@faa.gov. The schedule shall include, at a minimum, the following for each flight:
    a. UAS Type
    b. Takeoff time (all times local)
    c. Estimated land time
    d. FM Net and/or ATC call sign of PIC and/or observer.
    e. Observer name or initials
    f. Observer cell phone number (back-up comm)
    g. Chase aircraft tail number/call sign

    A NOTAM will be requested NLT 72 hours prior to UAS operations. The PIC will request a NOTAM via the Automated Flight Service Station (AFSS) at 1-800-487-6867. The following information, as a minimum, will need to be passed to the NOTAM representative:
    a. Date/time UAS activity will begin and end.
    b. A description of the operational area using a radial and DME within 4 NM of Jacks Creek VOR/DME (JKS 149/035). More than one radial and DME may be used to describe the area.
    c. The altitudes affected.
    d. Duration of the operation.
    e. Record the AFSS representative initials here: _____

5. **FREQUENCY AUTHORIZATION AND DE-CONFLICTION.** A list of frequencies required for operation will be provided to the ISR Range Services Range Control and MEM ARTCC for de-confliction and approval. ZME ARTCC may issue the frequency to be used/monitored. Radio checks with the appropriate ARTCC/FSS and any local regional airports (SME, KMKL and/or KSNH) will be coordinated and approved by the facility before UAS operations begin.
    a. ATC facility: _____
    b. Frequency: _____
    c. ATC facility commercial phone number for back-up comms: _____
    d. Local CTAF/UNICOM: _____

    A list of system frequencies that will be utilized will be provided to the ISR Range Services Range Control (731-607-9083, or Fax 731-925-6854) for de-confliction and approval. ISR Range Services shall coordinate these frequencies with Air Force Frequency Management Agency for de-confliction at (703) 428-1544.

6. **ISR RANGE SERVICES PROCEDURES.** The PIC, Observer, or designated team lead will pick-up FM net radios from the ISR Range Services Range Control and conduct a radio check one-hour prior to ensure the radio is fully operational. The same individual will verify that MEM ARTCC personnel have the UAS flight schedule for that day's UAS operations and a NOTAM has been issued.

7. **UAS OPERATIONAL AREA. (See figures 1&2)** The UAS area is defined as follows:
    Position Points: (WGS84)
    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"

In accordance with the SOCOM Airworthiness Safety Release for ScanEagle operations at ISR Range Services, VOs shall maintain a minimum 500 meter internal safety buffer from the defined COA boundaries. VOs are required to display the approved UAS airspace, Columbus 4 MOA MTR's, KSNH Class E airspace boundaries, and ISR Range Services Range boundaries on the GCS at all times.

8. PRE-FLIGHT PROCEDURES. ScanEagle operators will be responsible to routinely check current and forecasted conditions. It will be the responsibility of the PIC to ensure weather conditions do not exceed system limitations as described in Operator's Manual. All flight operations will be conducted in Visual Meteorological Conditions (VMC) under Visual Flight Rules (VFR). The - PIC will complete the Preflight checklist and conduct a pre-flight briefing. All flight operations will be scheduled and approved by Range Control/Airspace Manager prior to launch.

9. PRE-FLIGHT BRIEFINGS. Prior to any UAS operations, the PIC will complete the Mission Risk Assessment Worksheet and conduct a crew and safety briefing. The briefing will include, at a minimum, the following:

a. **Checklists**
   1) Aircraft preflight inspection status
   2) GCS checklists and status
   3) Skyhook checklist and status
   4) Catapult checklist and status
   5) Takeoff checklist status

b. **Crew Assignments**
   1) Mission Commander / Air Boss
   2) UAS operator
   3) Observers- GO, AO
   4) Engine start operator
   5) Catapult operator
   6) Post-capture Skyhook crew

c. **Mission Overview**
   1) Primary objectives
   2) Secondary objectives
   3) Estimated length
   4) Mission profile
   5) Risk assessment

d. **Launch Plan**
   1) Intended profile
   2) Camera setup
   3) Speed and pressure required

e. **Recovery Plan**
   1) Intended approach format
   2) Passes intended (number & height)
   3) Missed approach
   4) Camera setup

f. **Ambient Conditions**
   1) Weather
   2) Airspace status and de-confliction

g. **Emergencies**
   1) Lost communications
   2) Engine failure (take off, in-flight, approach)
   3) Emergency runways clear of obstruction
   4) Downed aircraft retrieval
   5) Fire extinguishers / first aid kit
   6) Emergency assistance

h. **Communications Review**
   1) Comm systems and frequencies
   2) Client connections and data feeds

i. **Spectator Safety**
   1) Launch safety
   2) In-flight tours
   3) Recovery safety

j. **Weather.** (current and forecasted)

k. **Airspace surveillance procedures.**
   1) Pilots responsibilities. Observer's responsibilities.
   2) Pilot responsibilities in the event of ATC notification of observed aircraft in vicinity of UA operations not in two-way communication.
   3) Pilot/Observer responsibilities when they observe an aircraft in vicinity of UA operations.

l. **Required items, mission equipment, and personnel.**

m. **Crew actions, duties, and responsibilities.**
   1) Emergency actions.
   2) Mission considerations and actions to be performed by VO/MO.

n. **Analysis of the aircraft. Logbook and preflight deficiencies.**

o. **Risk assessment considerations.**

p. **Comments:** Instructor, Mission Commander, Crew member, Observer questions, comments, and acknowledgment of the mission briefing.

10. LAUNCH and FLIGHT. There will be two locations from which control of aircraft can occur. The Launch and Recovery Site (LRS) will have 2 Ground Control Stations (GCS). 1 GCS will be used for controlling the aircraft flying in local patterns, while the other serves as a backup and to prep aircraft if a following launch sequence is required. The Forward Site, or 'Spoke' (a Hub and Spoke configuration: where LRS is 'Hub', handing off control to the Forward Site, or 'Spoke') will also have 1 GCS and 1 smaller, but equally capable, Tactical GCS (TGCS) as a backup. The Forward Site, or 'Spoke', will be responsible for mission flights. The difference between the 2 types of flights will be that local flights will last approximately 1 - 2 hours from launch to recovery and stay within 1 NM of the LRS GCS, while mission flights can last the entire day, or 1 aircraft aloft for up to 8 hours, and typically fly beyond 1NM of the 'Spoke' GCS. The 'Spoke' will accept handoff control of aircraft from the LRS and at the end of the mission day, return control of aircraft back to LRS for recovery. Both locations will have redundant control capability and have external GOs; mission flights going beyond 1NM of Spoke GCS will require chase plane with an AO following UAS. The Emergency Recovery location is separate from either control element to ensure that each control station has capability to recover aircraft safely. If the LRS location is unable to accept control and recover a 'Spoke' mission aircraft, safe recovery can still be completed via Emergency Recovery strip location for a belly landing, IAW Operator's Manual and paragraph 13 of this SOP.

The PIC will complete, at a minimum, the following:

a. Follow procedures outlined in the Operator's Manual.
b. Inform MEM ARTCC and local air traffic, by calls in the blind via CTAF/UNICOM, that the UAS is airborne.
c. UAS shall remain within CoA airspace of ISR Range facilities (figures 1- 3).
d. Operations will be conducted over a non-populated area.
e. Maintain positive communication with GOs or AOs for location of aircraft.

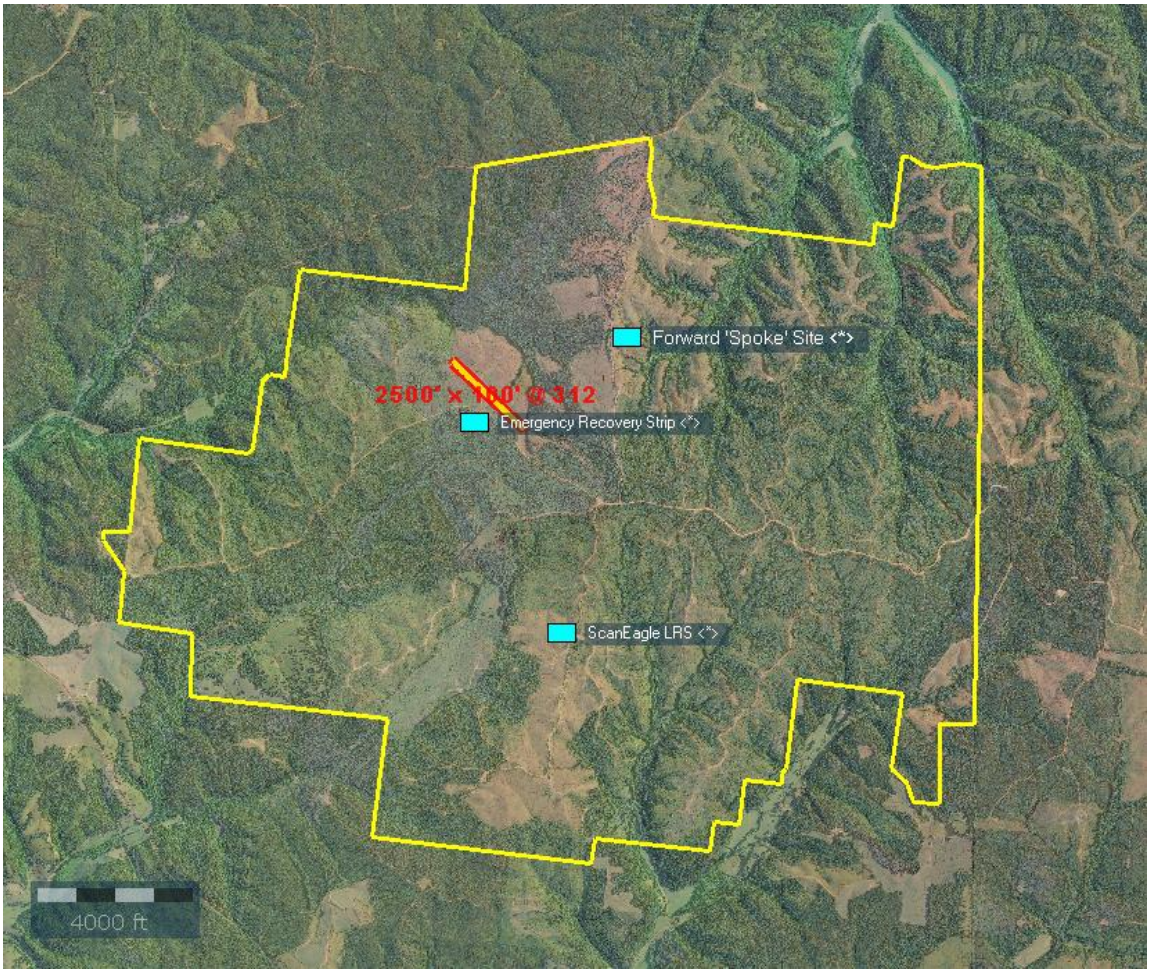

Figure 2. ISR Range Services Range Complex

11. **AIRSPACE MANAGEMENT.** During flight activities, airspace management will consist of deconflicting operational altitudes, horizontal separation, or a combination of both. For 2 aircraft aloft, airspace management will consist of vertically separating aircraft altitudes by 500 feet (relative to CoA approved altitudes), with the mission aircraft staying aloft above the local pattern aircraft flying shorter durations. Additional measures include individual Restricted Operating Zones (ROZ) being created, and aircraft would stay in their respective ROZ locations at pre-determined altitudes. This ensures that each aircraft is operating over a predetermined area, and at different altitudes to prevent conflicts. Airspace management and mission deconfliction shall be coordinated in the mission planning stage and all missions must be approved by the Range Control Cell prior to the commencement of flight operations. Also real-time management will be accomplished by both PIC's, communicating location and intentions via Range Control/Airspace Manager net and ensuring de-confliction in each location, or ROZ, per Range Control approval. Range Control will track locations of each aircraft with reports from each PIC and Visual Observer as well as remote video feeds. When Mission Aircraft recover, there will be no other local flight operations conducted IVO the LRS.

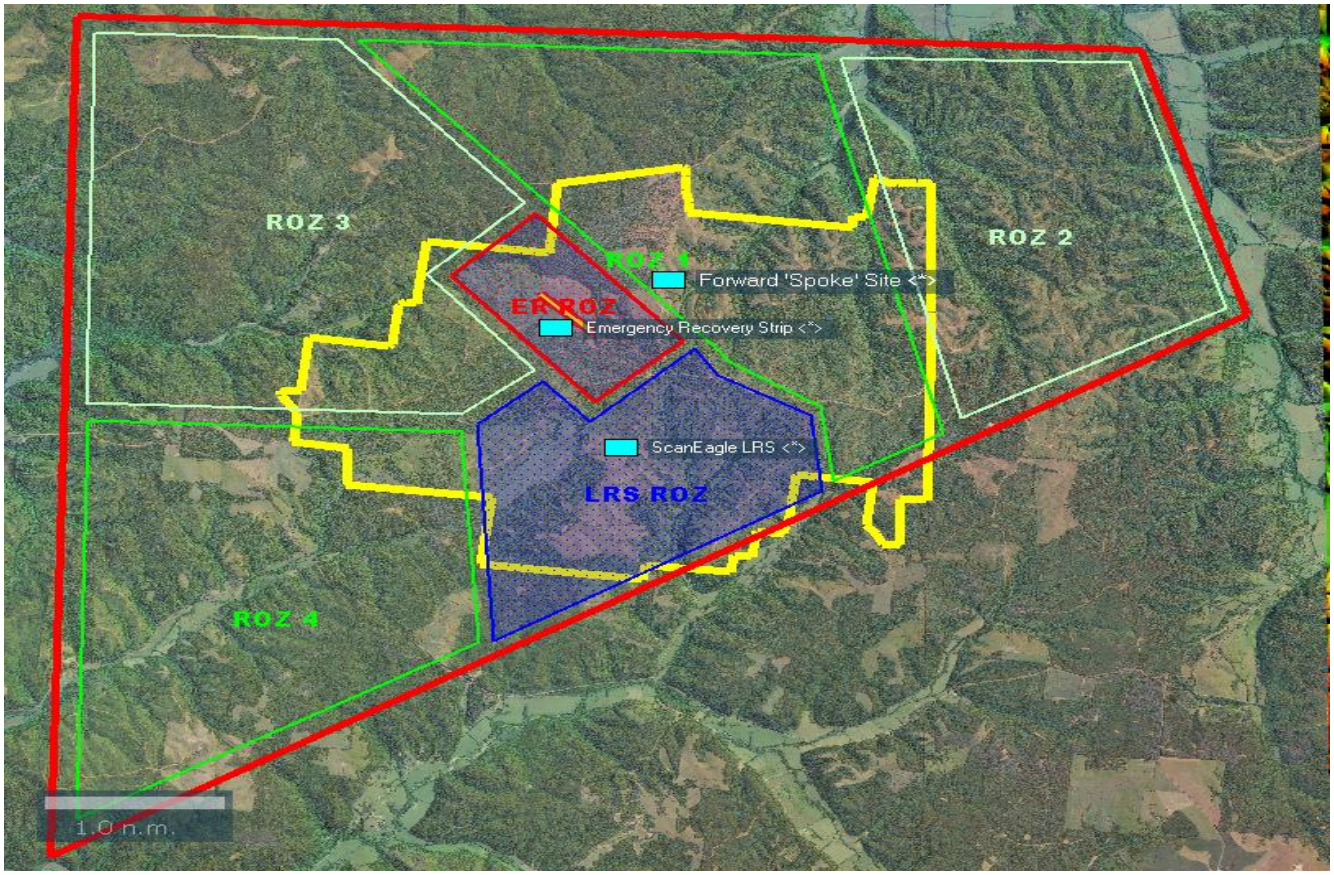

Figure 3, AIRSPACE MANAGEMENT. Illustration of each ROZ- LRS, Spoke ROZ' 1-4, and Emergency Recovery.

12. **POST FLIGHT PROCEDURES:** The PIC will complete, at a minimum, the following:
    a. Inventory and account for all equipment
    b. Report any discrepancies
    c. Conduct a visual and functional equipment inspection
    d. Complete an entry to the flight log
    e. Notify MEM ARTCC upon completion of daily activities.

13. **Emergency Procedures.** Emergency procedures for the ScanEagle are resolved via automatic logic and emergency procedure checklists. The following is a brief overview of basic safety-related considerations implemented during execution of the major emergency types. In each condition, appropriate coordination will be made between Ground Observers (GO) and Aerial Observers (AO, positioned via chase aircraft), ATC, Emergency Response Agencies (as required) and local air traffic via published frequencies as outlined in this SOP.

Emergency Procedures :

a. Launch Failures: The UAS is launched in a manner that ensures it is pointed in a safe direction, i.e., away from personnel, structures, or through-ways.

b. Engine Failures: In the unlikely event of an in-flight engine failure, the UAS is immediately directed to a pre-determined flight plan to a designated ditch point. The UAS autonomously flies back and forth over this area until it makes a belly landing. For this COA submission, a dirt runway has been cleared, and can be secured on both sides, to prevent passers-by accessing the runway during an emergency event.

c. Lost Comm/Data Link: (for greater detail and explanation, see item 13, Loss of Link)
If communications are lost with the UAS, the vehicle proceeds via a pre-determined flight path to its designated emergency hold point, where it maintains position for a pre-designated period of time. This hold point is located in the immediate vicinity of the GCS, so that while the UAS is holding, additional attempts can be made to re-establish

communications with the vehicle. If communication is not re-established, the UAS determines the real-time winds, determines the best direction to approach the pre-designated ditch point and executes a belly landing on the emergency ditch point. Lost Link PIC and ISR Group personnel shall ensure that any local flight operations at the LRS are terminated or relocated to an adjacent ROZ when Lost Link processes begin.

d. Recovery: The recovery flight path is predicated on prevailing winds. Should a missed approach occur, the UAS returns to the hold point and attempts another approach to recover when commanded.
e. Emergency Hold: An emergency holding pattern location has been established and pre-programmed for the UAS. If any emergency occurs, the UAS is sent to the holding pattern. Should a lost communications condition occur between the UAS and the GCS, the UAS intercepts a pre-planned route to the emergency hold pattern where an attempt is made to regain control of the communications/data link.
f. Emergency Landing: Should an autonomous Skyhook recovery not be possible, an emergency ditching site will have already been established to recover the UAS- one that poses a minimal hazard to all personnel.
g. Visual Observers : Observers, either Ground Observers (GO) or Aerial Observers (AO, positioned via chase aircraft), are present for all flight operations, according to altitudes flown (IAW paragraph , and have direct two-way radio communications with the Pilot in Command (PIC) of the aircraft in the GCS. The PIC, GO, and AO hold Class II FAA Medical Certificates and are trained/tested in applicable items of FAR part 91. The GO and AO continuously monitor the UAS and scan the surrounding air space for other aircraft. They provide see and avoid capability for all the UAS operations in the desired area. AO's will have redundant means of communication aboard the chase aircraft and will be able to communicate directly with ATC/FSS/Local Traffic if a communication failure occurs.
h. UAS health and status:
The UAS transmits health and status of the air vehicle and it's systems to the GCS, and all systems are monitored real-time by the UAS operator. Should the air vehicle parameters become degraded at any time, the operator will be notified by both visual and audible alarms, and will take appropriate immediate actions, initiating the emergency procedures as required.

14. **LOST-LINK PROCEDURES.** The UAV has a series of mission parameters which are 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 configurable in flight, these parameters are typically designed for a given launch and recovery site and are configured for the anticipated flight environment missions. The ScanEagle follows an autonomous lost-uplink procedure if communications from the GCS fail. This procedure ends in a belly-landing at a specified location if communications are not reestablished. Many elements of the procedure are configurable. For purposes of this COA submission, the aircraft will be preprogrammed to return to the center of a specified ROZ until communications are reacquired or the preprogrammed, 20 minute "wait at home" timer expires. If the "wait at home" timer expires and communication has not been reestablished, the aircraft will execute a belly landing at the Belly Landing/Engine-Out Recovery location, following the preprogrammed parameters. The attached graphic (Figure 4) illustrates the "wait at home" location with Point 92 and its current commanded location (ScanEagle 0) as left-hand holding entry points and Point 94 as the lost link route departure point for recovery. All lost-link procedure will be approved by the Airspace Manager, Range Control, as part of the mission checklist to ensure protection of airspace and de-confliction from other operations over ISR Group Range Services property and published daily via an Airspace Utilization Order.

ScanEagle Lost-Link Procedure:

a. The lost-link procedure begins after the 10 second link timeout timer has expired without the ScanEagle receiving any messages from the ground. The aircraft then flies at a safe airspeed, holds its altitude, and starts a periodic reset of its communication channels.
b. GCS/PIC notifies all Observers both ground and airborne (Chase Aircraft) about the issue and drives checklist procedures to coordinate actions accordingly.
c. The ScanEagle continues tracking its current flight-plan for start climb time.
d. The ScanEagle climbs for a designated period of time towards the highest of 3 altitudes; it current altitude, a safe altitude, or the calculated for line-of-sight communications with the GCS. Each of these altitudes are programmed prior to flight for mitigation of existing airspace boundaries.
e. The aircraft continues tracking its current flight-plan during the hold time. Observers continue sending reports to GCS/PIC of aircraft location and attitude.

f. The ScanEagle flies directly to the nearest waypoint in the abort flight plan that is not further from home than the aircraft's current position (in the table below, this would be waypoint #'s 96). The aircraft then climbs to the new flight plan altitude if it is higher than the current altitude. Observers are stationed at recovery point and send reports as cued by GCS/PIC as to aircraft location and attitude.

g. After reaching the home holding pattern, the aircraft waits for the 20 minute "wait at home" timer to allow the ground crew to reestablish communications and/or secure the landing area.

h. GCS/PIC calls local ATC/FSS (KMKL: Tower- 127.15/249.95; CTAF- 127.15; UNICOM-122.95; JACKSON RCO 122.2 122.65 127.15 (JACKSON RADIO)) and/or ZME ARTCC (134.65/316.15) as required, and Guard Freq's (KSNH: CTAF/UNICOM 122.8) of landing operations per established launch/recovery communication procedures. If radio contact not capable, call 1-800-WX-BRIEF to contact FSS and have information relayed to ZME and other concerned parties.

i. If communications have still not been reestablished, the ScanEagle selects an appropriate approach and touchdown point on the pre-selected ditch point for a belly landing. This ditching selection considers the current winds as measured by the aircraft, and the location previously programmed into memory.

j. Observers monitor aircraft as it completes landing evolution and send reports of positive recovery to GCS/PIC. GCS/PIC advises ACT/FSS/Local traffic of completion of recovery ops.

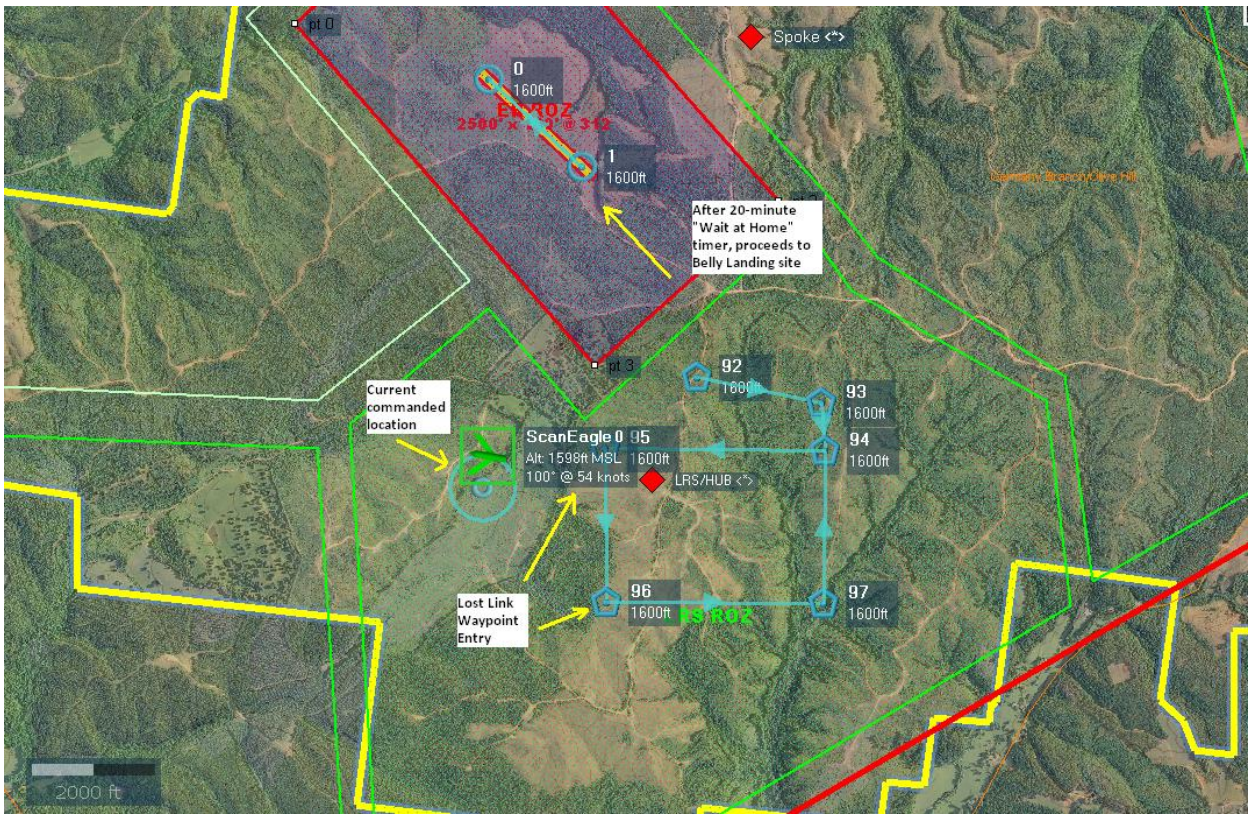

Figure 4. Example Emergency Recovery for ScanEagle UAS (IMUSE simulation)

15. **Emergency Recovery Location.** In Figure 4 you can see the locations of the Launch/Recovery Site (LRS), and the Belly Landing/Engine Out Recovery location (in RED), and all pre-programmed flight plan waypoints the aircraft navigates by. The aircraft can be pre-programmed to auto-land at this purpose-built location if there are any complications with normal flight activity. As an added benefit, these built-in simulation capabilities allow operators to continually be tested with simulated potential failures on their ability to utilize the Belly Landing, Engine-Out and Lost-Link Recovery protocols prior to actual flight events at ISR Range Services facilities.

16. **LOST COMMUNICATIONS PROCEDURES.** Communications between ground observer and GCS will be maintained by hand-held radios. If communications are lost between an observer and the GCS/PIC, the Observers will relay information to the nearest observer that has communications with the GCS, or by use of a mobile telephone, directly to the Mission Commander within the

GCS. If communications cannot be restored between the observers and the CGS, then the PIC shall direct the aircraft to recover to the skyhook final approach fix and engage the skyhook.

Airborne observers will communicate via the same method and must maintain radio contact with the GCS for continued Scan Eagle operations that exceed 2000' MSL. In the event direct communications are lost between airborne visual observers and the PIC, the Scan Eagle shall be brought to within 2000' and 1 NM of the GCS to achieve ground observable line-of-sight for mission continuation. If this cannot be accomplished, then mission termination is mandatory as described above.

If radio contact is lost with ATC, the PIC will attempt to contact by alternate means of communication such as another radio and/or frequency, a telephone, or via the pilot and observer aboard the chase aircraft. With ATC approval, this may be employed until normal communication methods are restored. If communication with ATC is not possible, the flight will be terminated by executing a normal aircraft recovery to the skyhook final approach fix. PIC shall maintain ATC assigned squawk and Mode C and pass information to ATC as soon as possible.

17. MISCELLANEOUS

a. The United States Special Operations Command and/or its representatives are 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. ISR Range Services may assist with this effort, when required, in providing Visual Observers and Airspace Management.

b. Incident / Accident Reporting: The following information is required to document unusual occurrences associated with UAS activities in the National Air Space System.

   i. The following shall be submitted to Donald.E.Grampp@faa.gov within 24 hours:
      - Deviations from the "Special Provisions" contained in the COA.
      - All periods of Loss Link, including duration.
      - All incidents involving the UAS as defined in 49 CFR 830.
      - All accidents involving the UAS as defined in 49 CFR 830.

   ii. The proponent for the COA shall provide the following information to Donald.E.Grampp@faa.gov on a monthly/annual basis (Note: reporting is not required until the first flight occurs. Then reporting must continue on a monthly/annual basis even when no flights are executed):
      - Number of flights conducted under this COA.
      - Pilot duty time per flight.
      - Unusual equipment malfunctions (hardware/software).
      - Deviations from ATC instructions.
      - Operational/coordination issues.
      - All periods of Loss of Communications.
      - All spill outs from COA airspace.