

Emergency Operations



Goals of This Lecture

According to the FAA's UAS Airman Certification Standards, a Remote PIC should be able to demonstrate knowledge of:

- Emergency planning and communication.
- The characteristics and potential hazards of lithium batteries:
 - Safe transportation, such as proper inspection and handling.
 - Safe charging.
 - Safe usage.
 - Risks of fires involving lithium batteries.
- Loss of aircraft control link and fly-aways.
- Loss of Global Positioning System (GPS) signal during flight and potential consequences.
- Frequency spectrums and associated limitations.

The Safety Myth: "It Won't Happen To Me"

**It's a dangerous perception in
this business.**

**“Safety is something that happens
between your ears, not something
you hold in your hands.”**

— Jeff Cooper

Planning for an Emergency



Overview of Emergency Planning



As a remote PIC, you are ultimately responsible for briefing the participants — clients, crew members, other ground-based crew — about emergency procedures.

Key considerations:

- Points of failure.
- Approach of unmanned aircraft.
- Approach of people.

It's important to understand what could go wrong and plan for it.

Conducting a Site Survey

Get to know your environment ahead of time to identify:

- Hazards like towers, power lines, trees, and other structures.
- Radio interference that could compromise communication signals between the remote controller and the aircraft.
- Magnetic interference.
- Traffic patterns of vehicles that could be endangered by your operation.
- Non-participatory bystanders.
- Wind obstructions that can create turbulence.

An UAS usually uses radio frequencies (RF) for communications between the control station (CS) / transmitter and the UA.

- Most UAS use 2.4 GHz and 5.8 GHz.
- But there can be interference.
- Loss-of-control (LOC) and fly-aways are some of the reported problems with sUAS frequency implications.
- To avoid interference, many sUAS use 5.8 GHz to control the UA and 2.4 GHz to transmit video / photos to the ground.

Both 2.4 GHz and 5.8 GHz frequencies are considered line-of-sight.

- Command and control link between the CS and the UA will not work properly through barriers.
- Must maintain VLOS.

You must always use unlicensed (or approved) frequencies.

- Some frequencies are unlicensed and can be used freely (e.g., 900 MHz, 2.4 GHz, and 5.8 GHz) without FCC approval.
- All other frequencies require a user-specific license for all civil users, which must be obtained from the FCC.

Characteristics and Potential Hazards of Lithium Batteries



Overview of Lithium Batteries

Most sUAS used lithium-ion polymer (LiPo) batteries.

- Rechargeable.
- Multiple power capacities and sizes.
- Can last 200-300 cycles if properly cared for.

You need to take important steps to extend your battery life and stay safe.

Best Practices for Li-Po Batteries

- **DO** use a safety bag or fire-proof container for charging, discharging, and storage.
- **DO NOT** use your flight/travel case for long term storage.
- **DO NOT** put it in your checked baggage - use a carry-on.
- **DO** protect each spare battery to prevent short circuits.
- **DO NOT** let them contact metal objects like coins, keys, jewelry.
- **DO NOT** allow crushing, puncturing, or pressure on the battery.
- **DO NOT** use a damaged or puffy / swollen battery.
- **DO** follow proper battery disposal procedures.
- **DO NOT** buy used batteries or batteries from unknown sources.

Best Practices for Li-Po Batteries

- **DO** store batteries in a cool, dry place.
- **DO NOT** store them in a hot place.
- **DO NOT** store them in a refrigerator - it can cause condensation.
- **DO NOT** charge a battery that is still warm from usage.
- **DO NOT** use a battery that is still warm from charging.
- **DO NOT** use them in cold weather - it shortens battery life.
- If operating in the cold:
 - **DO** fully charge batteries before each flight.
 - **DO** warm batteries to ~75°F (25°C) or more before flight.
 - **DO** hover for 30-45 seconds to warm up the battery.

Best Practices for Li-Po Batteries

- **DO** use a proper LiPo battery balance charger/discharge if you're charging a battery that has more than one cell.
- **DO NOT** leave batteries charging while unattended.
- **DO** be prepared if a battery becomes puffy, smoky, or catches fire (small fire extinguisher is a good idea).
- **DO NOT** over-charge beyond 4.2v per cell.
- **DO NOT** "trickle" charge (when it's plugged in 24/7).
- **DO NOT** discharge below 3.0v per cell.
- **DO NOT** leave batteries fully charge for more than a couple of days. Discharge to 3.6v-3.8v per cell for safe storage next use.

Handling an Emergency



If you encounter an emergency situation while flying, rule #1 is to maintain your aircraft control.

Failsafe Systems

- Many UAS come equipped with autonomous failsafe systems where the drone will pause, auto-land or return home, depending on the situation and the emergency.
- Be familiar with these systems, as some are optional and must be set by you.

Emergency Maneuvers

Examples of situations that might trigger an emergency maneuver:

- Loss of orientation
- Loss of GPS signal
- Compass error
- Loss of direct line-of-sight
- Loss of video feed
- Fly-away
- Erratic movement
- Structures in line of flight
- Birds

Emergency Maneuvers (Cont'd)

After you've maintained control of your aircraft, you may need to conduct an emergency maneuver.

Best practices:

- Always be prepared to switch to your aircraft's "manual" mode during an emergency.
- Land safely as soon as possible and turn off your aircraft.

Emergency Maneuvers (Cont'd)

Aircraft wing vortices can cause an emergency if not detected:

- Wingtip vortices are disturbances in the air created by large aircraft when they are producing lift.

Another situation is during a head-on-head collision course:

- Both pilots should give way to each other to the right.

What to Do After an Emergency

1. Document everything that happened during the incident:
 - What was the date and time?
 - Who was flying?
 - What were they flying?
 - What was the circumstance or cause of failure, if known?

What to Do After an Emergency

2. Report an accident to the FAA within 10 calendar days if it meets either of these criteria:
 - Serious injury to any person or any loss of consciousness.
 - Damage to any property, other than the small UA, if the cost is greater than \$500 to repair or replace the property (whichever is lower).

Options to Submit the FAA Report



- Electronically to the appropriate FAA Regional Operations Center (ROC) here: <http://www.faa.gov/uas>
- By phone to the ROC
- Nearest jurisdictional Flight Standards District Office (FSDO): http://www.faa.gov/about/office_org/field_offices/fsdo

What to Include in Your Report

The report should include the following information:

- sUAS remote PIC's name and contact information.
- sUAS remote PIC's FAA airman certificate number.
- sUAS registration number issued to the aircraft.
- Location of the accident.
- Date of the accident.
- Time of the accident.
- Person(s) injured and extent of injury, if any or known.
- Property damaged and extent of damage, if any or known.
- Description of what happened.

Report Deviations from Part 107

- If the remote pilot-in-command had to deviate from any of the Part 107 rules to respond to the emergency, the PIC must also send a written report, only upon the FAA's request, that explains the deviation.
- For example, if you had to go up to 600 ft. altitude to avoid a manned aircraft, you'd be violating the Part 107 maximum altitude provision, and that's something for which the FAA might want an explanation.