

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



DCA25LA065

SYSTEMS

Specialist's Factual

Report May 2026

Table of Contents

A. ACCIDENT	3
B. SYSTEMS.....	3
C. SUMMARY	3
D. DRONE LIGHT SHOW OPERATION SYSTEM DESCRIPTION	3
1.0 HARDWARE.....	3
2.0 SAFETY AND GEO-FENCING	9
3.0 CREW RESPONSIBILITIES	10
E. DETAILS OF THE INVESTIGATION	11

A. ACCIDENT

Location: Orlando, FL
Date: December 21, 2024
Time: 1830 eastern standard time (EST)
Airplane: UVIfy IFO

B. SYSTEMS

Group Chair	Rob Wansker National Transportation Safety Board Washington, DC
Group Member	Kurt Gibson National Transportation Safety Board Washington, DC
Group Member	Christopher Babcock National Transportation Safety Board Washington, DC

C. SUMMARY

On December 21, 2024, about 1830 eastern standard time, multiple small unmanned aircraft (sUA) experienced a loss of control and rapid descent while performing at a sUA light show at Lake Eola, Orlando, Florida. The swarm of sUA, Uvify IFO, were operated by Sky Elements LLC, doing business as (dba) Sky Elements Drone Shows. A minor child was impacted in the face and chest by a sUA and was seriously injured. A postaccident inspection revealed that numerous sUA impacted the ground and sustained substantial damage. The sUA light show was operating under the provisions of Title 14 *Code of Federal Regulations* Part 107 and a Certificate of Waiver and authorization issued by the Federal Aviation Administration (FAA).

D. DRONE LIGHT SHOW OPERATION SYSTEM DESCRIPTION

1.0 Hardware

The operator, Sky Elements, uses the UVIfy IFO drone (sUA), which is powered by a Lithium Polymer 5800 mAh battery 4 cell battery at 14.8 Volts. The dimensions of the sUA is 15.7 inches wide, 15.7 inches long, and 5 inches in height. It has a total weight of 2.3 pounds and has a maximum operational speed of 37.3 miles per hour (mph). The maximum operational flight time (with min 30% battery remaining) is 20

minutes. It has a range of 2 kilometers (km). See Figure 1 for detailed specifications of the sUA.

TECHNICAL SPECIFICATIONS

Aircraft	
Type	Quadcopter
Dimensions	27.5 cm x 27.5 cm (without propellers) 40 cm x 40 cm (with propellers)
Height	12.5 cm
Rotor diameter	7" (~18cm)
Number of rotors	4
Weight	635 g / 1,050 g (with battery)
Max. flight time	25 mins (with 4S, 4200 mAh battery, hovering, no additional payload)
Max. airspeed	60 km/h
Max. takeoff weight	1.7 kg
Max. control range	1 km (with supplied remote control)
Max. operational altitude	500 m (height above sea level)
Max. sustained wind	15 knots
Remote frequency	2.4 GHz (Remote control) 2.4 / 5.8 GHz (Wi-Fi) Sub 1 GHz (Telemetry)
Hover accuracy range (RTK enabled)	Vertical: ± 0.1 m Horizontal: ± 0.1 m
RGB LED	27W, 840 lm (max)
Electronic speed controller	Designed and manufactured by UVify
Motor	Designed and manufactured by UVify Direct drive 3-phase brushless DC motor
Battery	Lithium Polymer 4S 4200 mAh 415 g 14.8 V

Remote Control	
Transmitter	DSMX compatible transmitter
Receiver	DSMX compatible receiver



Figure 1. Technical specification for the UVify IFO drone (courtesy of Sky Elements).

The operator has a ground control station that has two computers (Command Laptop and Red Button laptop) that run the Drone Dance Control software (DSS). The design process of the light show begins by creating the show in a three dimensional (3D) animation software (Blender). The 3D animation software will output a flight path for each individual sUA using a plugin "Drones add-on". Blender has automated algorithms that vary the following for each flight path: speed, distance between each sUA, and collision detection for each flight path. DSS has a "Path Viewer" software which is part of the software suite that will also do this verification after the paths have been exported.

During the drone light show, the operator will use two laptops to run the DSS. The primary laptop will run a full instance of DSS and the secondary laptop will be running DSS in red button mode.

In full instance mode there is a list of each sUA that is connected to the system. In the primary laptop display, full instance mode provides visual notifications of errors

as well as an available notification if a malfunction or other problem is present. The parameters of the sUA that are displayed in the full instance of DSS include, but are not limited to include: telemetry, start time, time to land, path, heading, battery, vertical speed, ground speed, GPS fix, vibrations, data length, and geo fence status. The parameters displayed on the DSS command station provide immediate notification if there is a problem that needs to be addressed for a single sUA or multiple sUAs. DSS allows for the remote pilot in command (RPIC) to select one sUA or multiple sUAs should a problem arise. Should a problem arise visually or on the DSS software during the operations for a single or multiple sUA the RPIC can select the problematic sUAs and can send them commands to hold (stop in air), return to home (have the sUAs return to their starting positions), land (land the sUAs in their current position), or as a last resort disarm. The disarm command is a command that will terminate all the motors of the sUAs which will cause them to fall from the sky. See Figure 2 for a screen shot of DSS running in full instance mode.

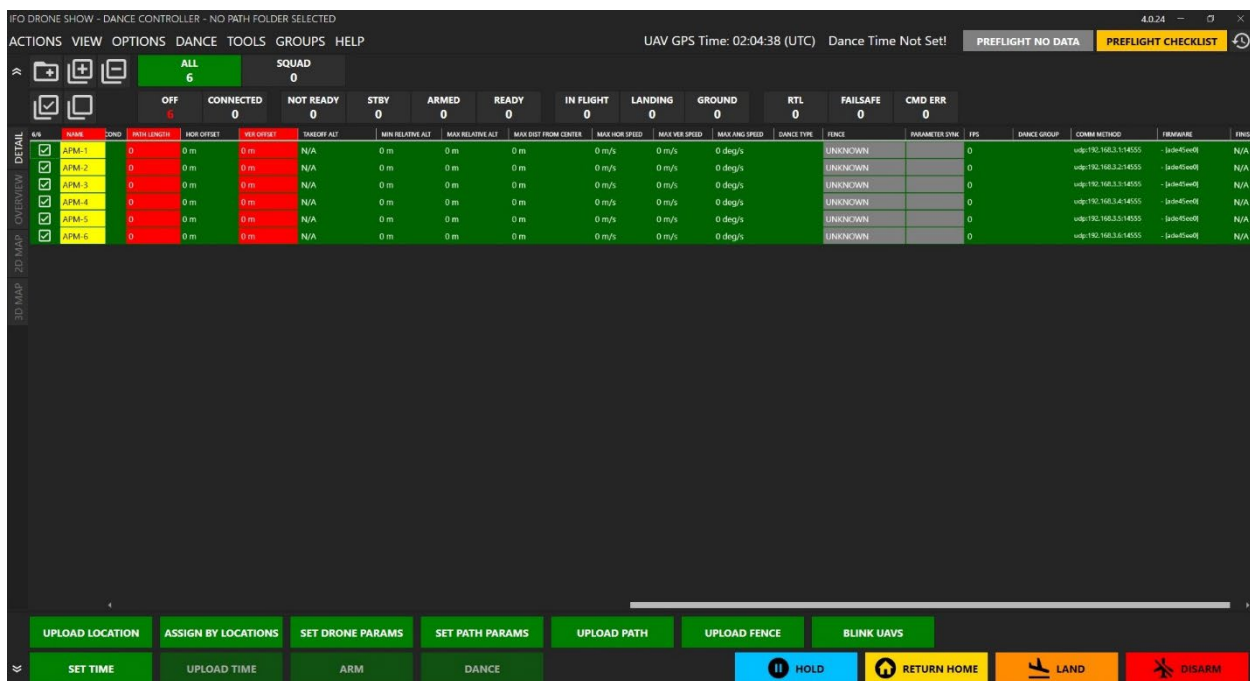


Figure 2. Full instance mode.

During operations, there will be a secondary laptop running DSS in red button mode. Red button mode is still able to communicate with all the sUAs, but it shows limited data and is designed to act as a quick access resource to take control of sUA(s) during a performance. In red button mode each sUA is displayed by number with the four commands accessible immediately as to each sUA as well as the global commands to all sUAs. Furthermore, in red button mode an operator can turn an sUA a specific color on the ground or in the air so that it is easily identifiable. See Figure 3 for a screen shot of DSS running in red button mode.

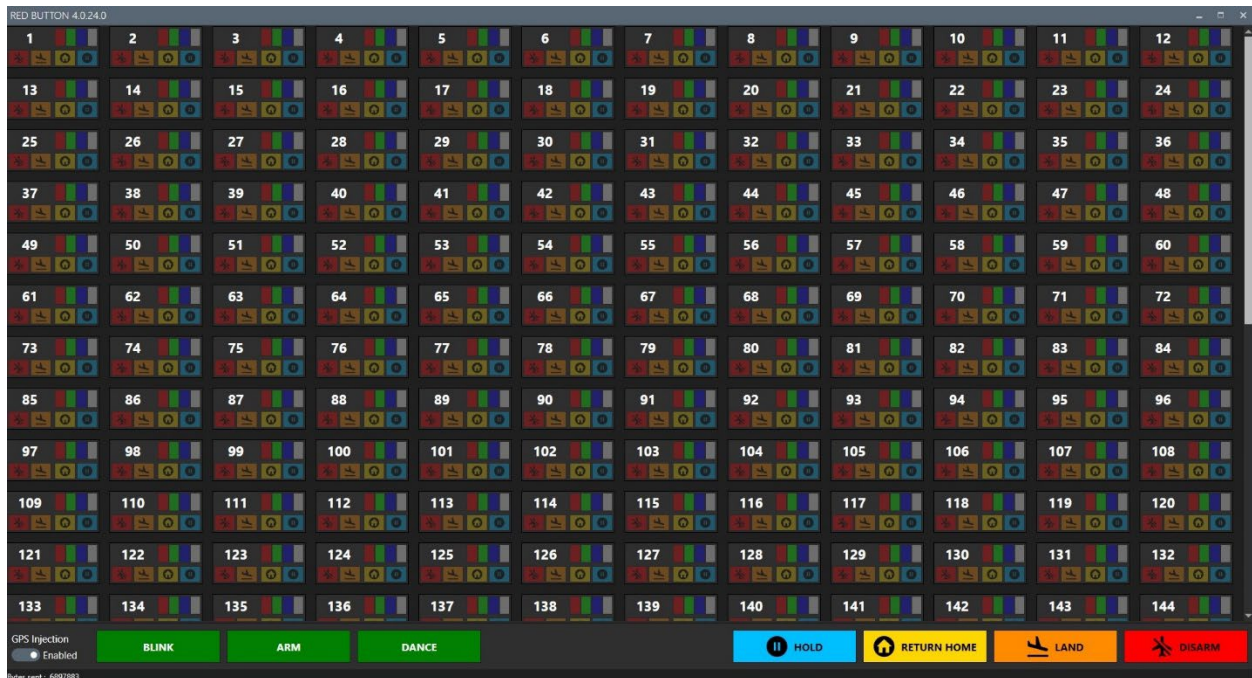


Figure 3. DSS red button mode.

In the field, the operator uses a Real Time Kinematics (RTK) system which has centimeter-level GPS precision, which prevents the possibility of a collision between drones caused by windspeed or drift (see Figure 4 for RTK system hardware). The operator will need to setup WIFI access points (AP) around all of the sUAs to communicate commands to the drones. Depending on the size of the show, up to eight APs may be used. See Figure 5 for example of an advanced communication kit with four APs. A base Sub-1GHz radio frequency (RF) antenna is utilized to assist with directionality of the sUAs. The RF antenna must be parallel to the sUAs secondary telemetry antennas on the ground while in the field for calibration and setup prior to the show. This allows the drones to move into their precise locations during the show without crossing paths with each other. See Figures 6 and 7 for RF antenna installation detail. In order to connect all the hardware together, the operator utilizes a network rack which creates a closed broadcasted WIFI network that is encrypted so no devices besides the sUAs and the Command Computers will be connected, see Figure 8 for complete connection diagram.

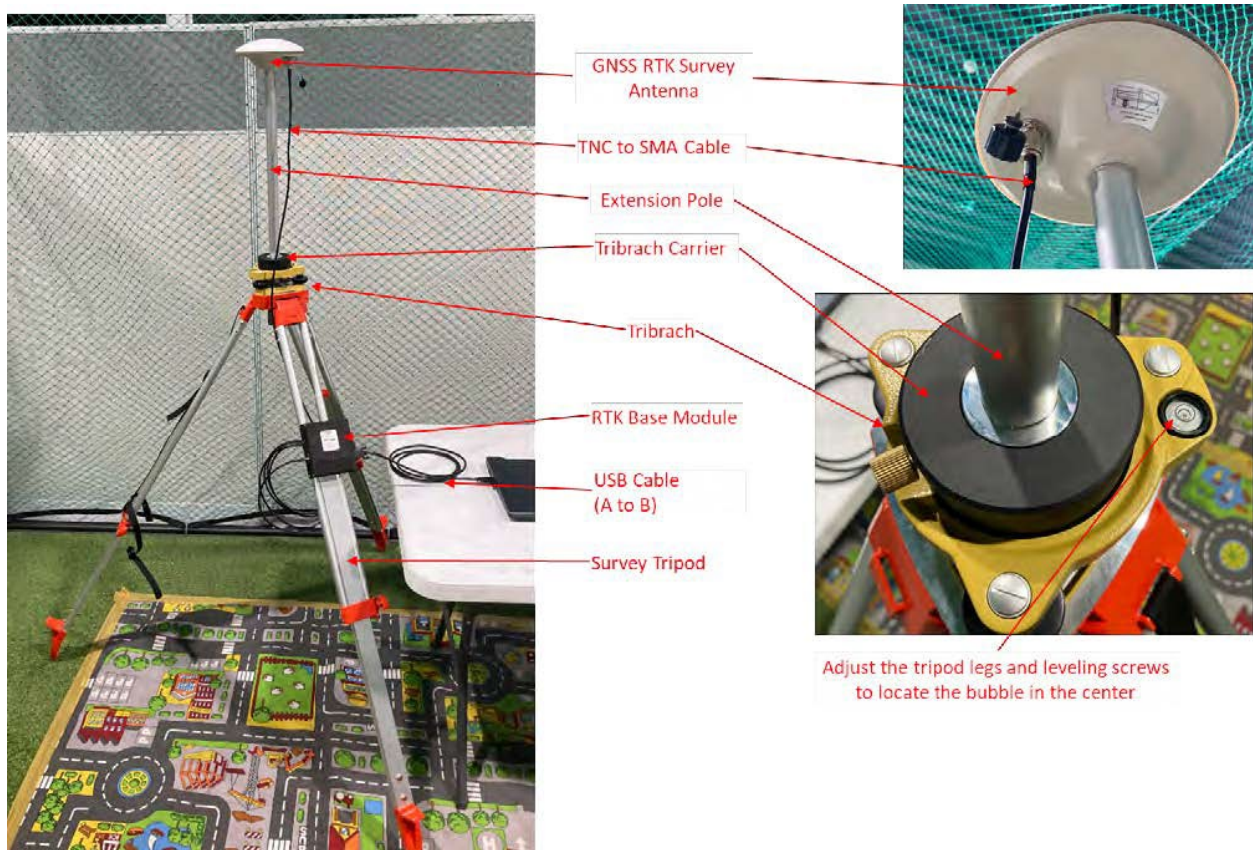


Figure 4. RTK system hardware.

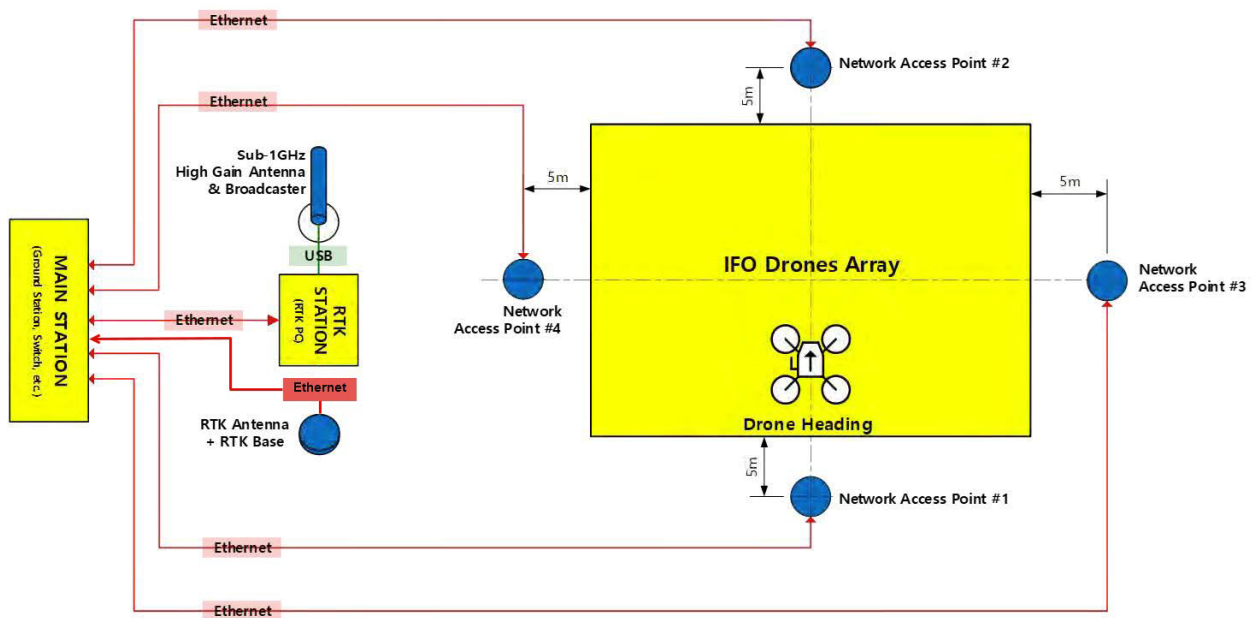


Figure 5. Advanced communication kit (using 4 APs).

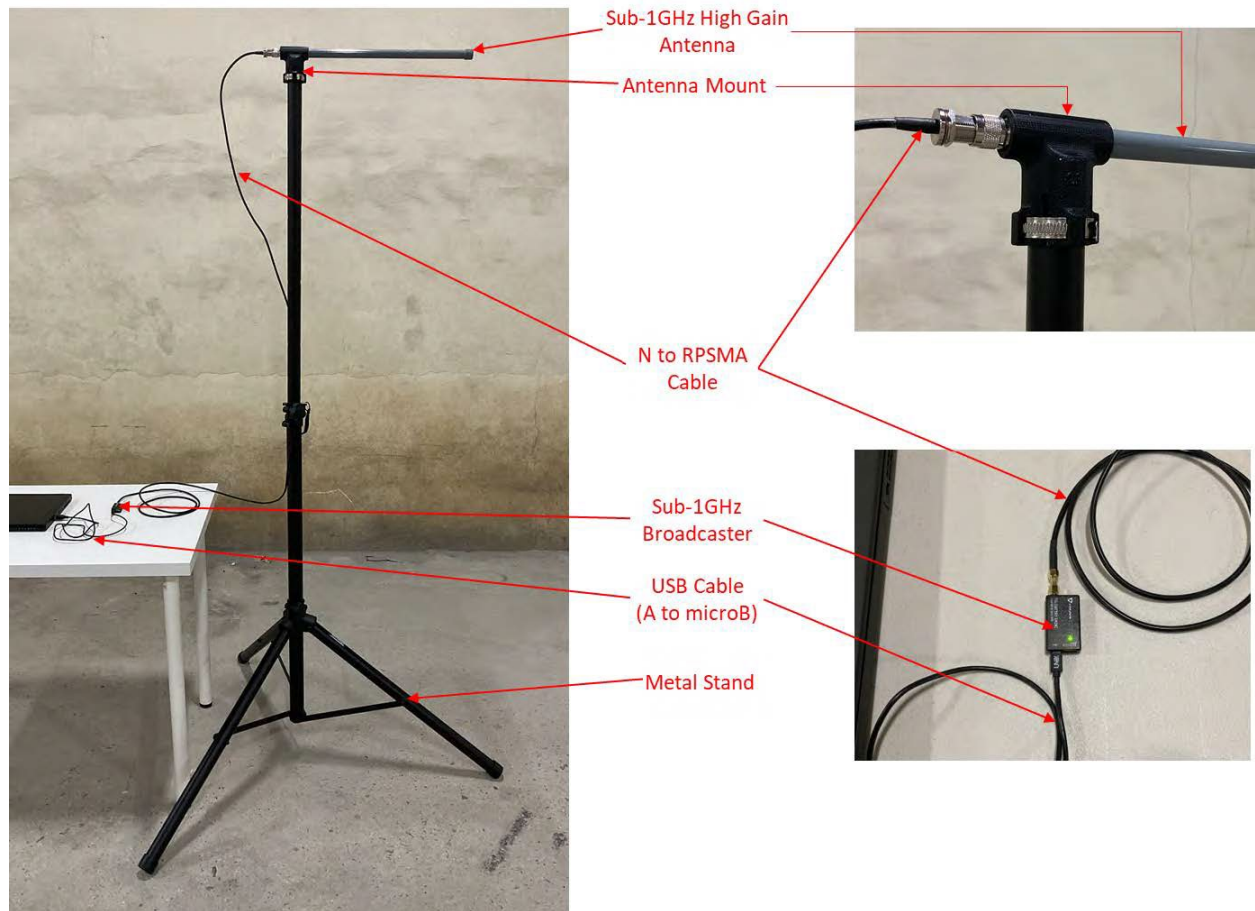


Figure 6. RF antenna.

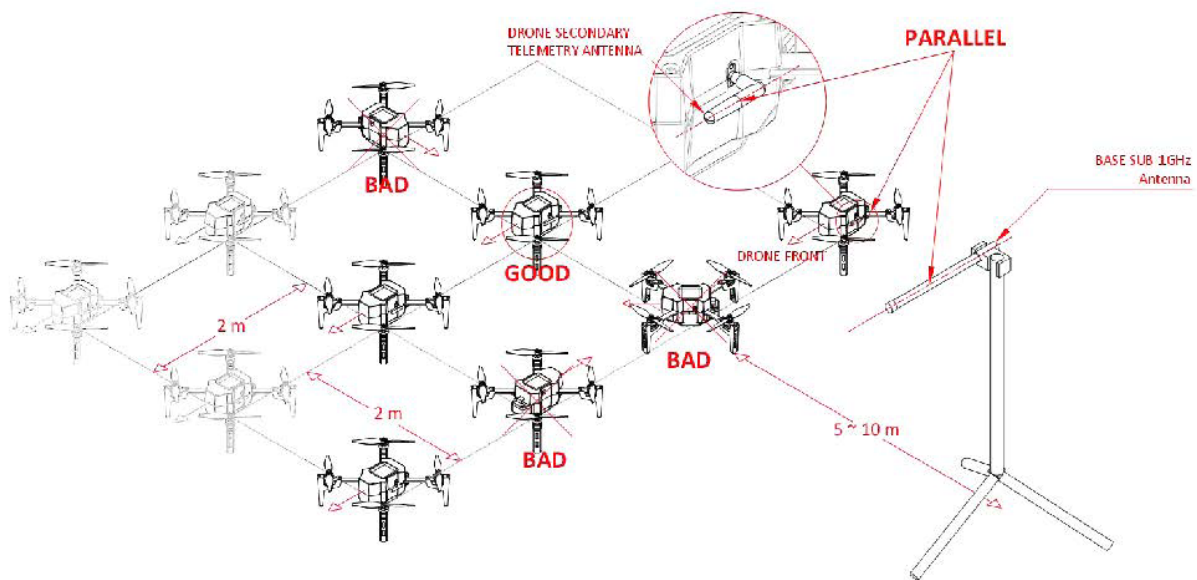


Figure 7. RF antenna installation parallel to sUAs antennas.



1. Secondary channel: This allows the RPIC to have a redundant transmission to the RTK base station.
2. Backup power generator: No loss of power at the GCS. A 2000Wh/2000w Portable power station that will provide 10 hours of power. This is fully charged before each drone show.
3. Redundant control link: Two independent data links handling command telemetry data transmission on the drones. The first link is WIFI, the second link is RF.
4. Safety modes: Hold, return to home, land, and disarm.
5. Two Geofences: The interior (normal) geofence is a "return to home" function that forces the sUAs to return to their starting position. The exterior (hard) geofence is a "disarm" function that will disarm the drones and cause them to fall within the buffer zone.

See Figure 9 for a typical drone show restricted area.

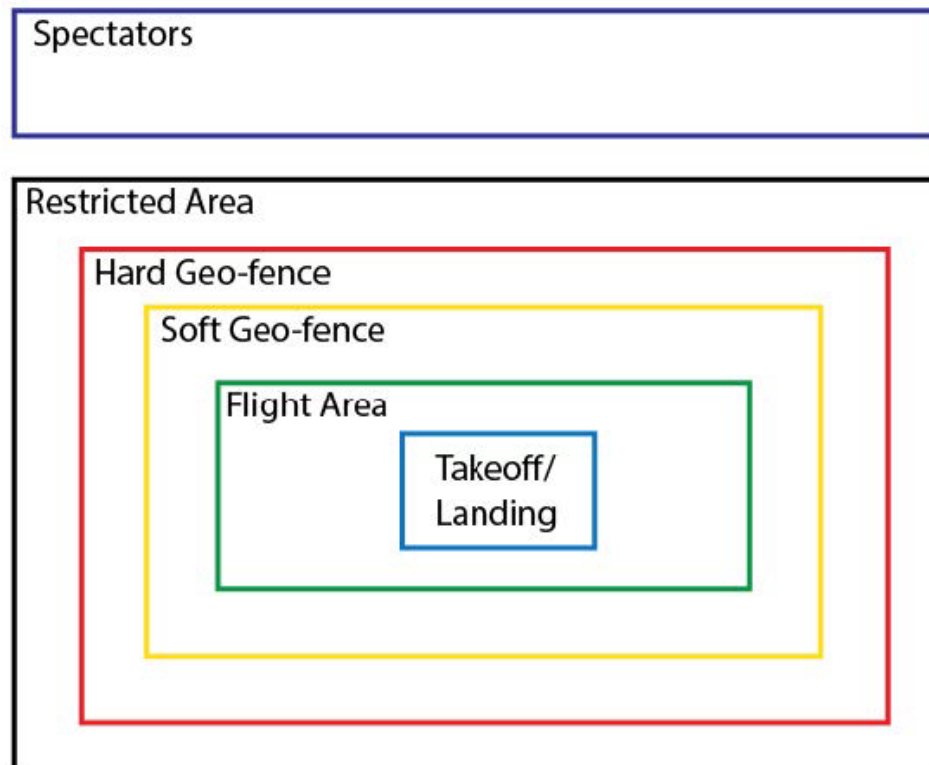


Figure 9. Restricted area setup during drone shows.

3.0 Crew Responsibilities

At the time of the accident, Sky Elements had two roles for personnel at each drone show. They have a remote pilot in command (RPIC) and a visual observer (VO).

Note: During the accident show, there was no co-remote pilot in command (CRPIC). Following the accident, Sky Elements changed their requirements to add a CRPIC.

A RPIC must be designated before or during the flight of the sUAs. The RPIC is responsible for and is the final authority as to the operation of the sUAs system. The RPIC must ensure that the sUAs will pose no undue hazard to other people, other aircraft, or other property in the event of a loss of control of the sUAs for any reason. The RPIC must ensure that the small sUAs operation complies with all applicable laws and regulations. The RPIC must have the ability to direct the sUAs to ensure compliance with the applicable provisions of applicable laws.

The CRPIC is primarily responsible for ensuring all safety checks have occurred by the RPIC.

The VO is the person who is designated by the RPIC to assist the RPIC and to see and avoid other air traffic or objects aloft or on the ground before and during the drone show.

E. DETAILS OF THE INVESTIGATION

The RPIC reported that the light show consisted of 500 sUA launched from a small peninsula in the northeast corner of Lake Eola. Setup for the day was standard and consisted of preflight checks, ensuring that the software programming matched and was updated on all show computers, and the layout of the 500-drone grid on the ground. This layout had one RTK and four APs, with each AP in a corner of the grid formation.

Review of the show videos from various spectators by the NTSB confirmed that the aircraft did not liftoff in uniform layers and as they illuminated and moved to their first frame of animation, they shifted position and altitude which resulted in a collision with other aircraft and a loss of control. After the collisions occurred numerous aircraft could be seen falling from the sky and impacting the ground. One aircraft could be seen streaking towards the audience. The drone that struck the spectator was not captured in any of the show videos. A detailed investigation of the drone that struck a spectator is in the NTSB Recorder's Factual Report in the docket.

The operator reported that a review of aircraft logs revealed that the show position was rotated by 7°. The 7° misalignment resulted in the geo hard fence being too close to the audience. In addition, the soft fence margin was set to 5 meters rather than the company's standard of 1 meter. The combined errors resulted in a reduced safety area that was outside of the company's standards. See Figures 10 and 11 for the sUAs grids as designed and as flown.

Following the accident, Sky Elements implemented the following mitigations:

1. Two extra hours to setup each show - 8 hours total.
2. Two RPIC to check flight path data, secondary person is the CRPIC.
3. Paper checklist in lieu of a digital checklist. Signed by both RPIC/CRPIC.
4. If RPIC is not 100% ready by 15 min before the show starts, the show start time will be pushed back.
5. RPIC cannot rotate or change path on ground.
 - New custom ground control software will not allow changes.
6. Bubble fence added. Like soft fence, Sky Elements considering only a hard fence.
 - 4-5m bubble radius tracks each sUA's absolute path during the show.
 - New software/firmware installed.

7. Hard fence used to be 5m, now 1m. Soon to be 0.5m. Eventually go to one primary hard fence.
8. New software makes hard fence 2m around show path automatic. 1m soft fence.
9. Retraining pilots.
 - Annual training.
 - Training with each new software release.

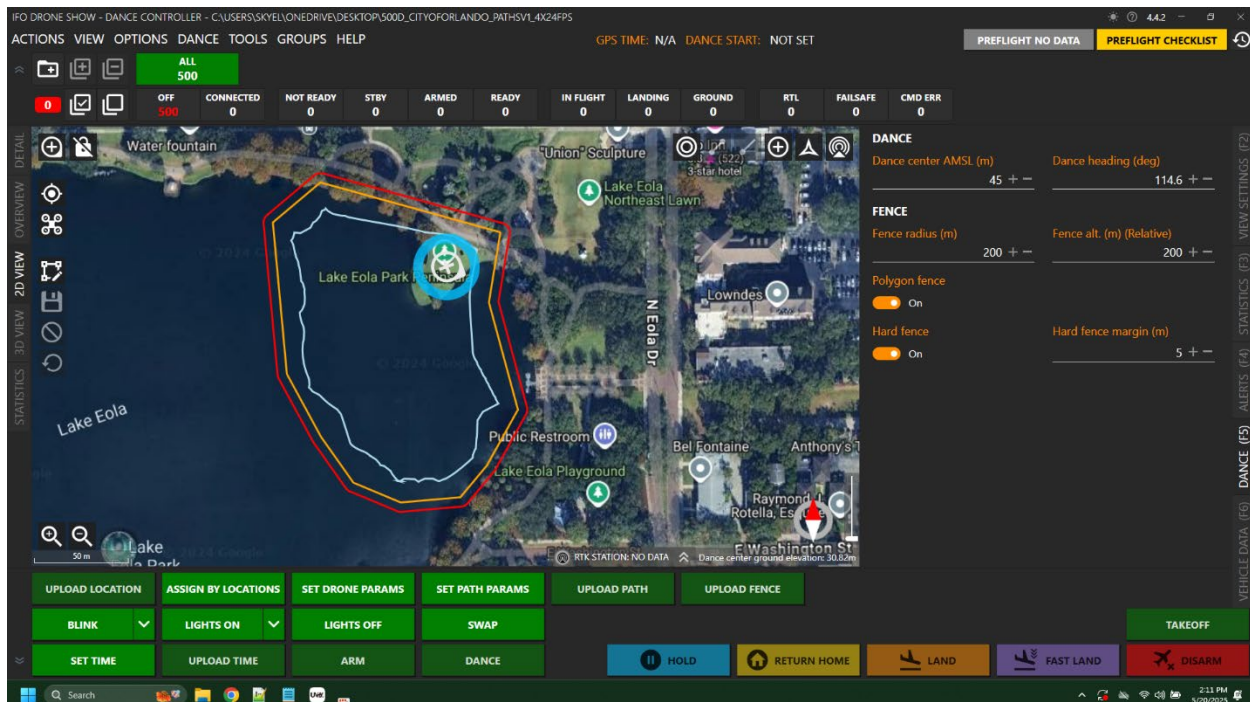


Figure 10. Grid as flown during accident with 7 degree offset (yellow – soft fence, red – hard fence).

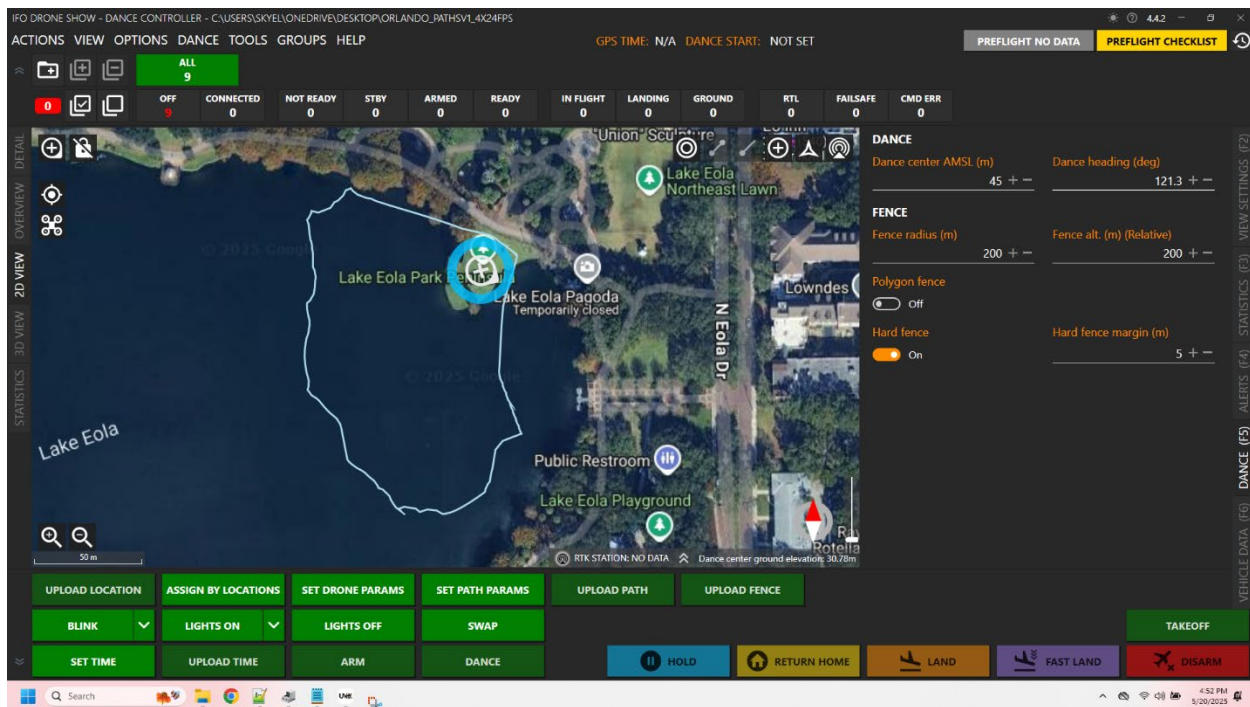


Figure 11. Grid position as designed.

Submitted by:

Rob Wansker
Aerospace Engineer