Sam Houston State University UAS Use Checklist

The FAA Part 107 of the Code of Federal Regulations and the Sam Houston State University President's Office Policy PRE-27 determine the minimum requirements for the use of Unmanned Aircraft Systems (UAS) on the Sam Houston State University (SHSU) property and by SHSU employees at other locations as a part of their employment. The following checklist must be followed by SHSU employees' use of UAS as part of their employment as well as outside contractors employed by the SHSU.

- Pilot in Command (PIC) provides up to date FAA certification for the piloting of the UAS.

- PIC identifies Visual Observers (VO) who will monitor UAS flights.

- PIC confirms Visual Line of Site (VLOS) procedures for UAS flights.

- PIC possesses a current maintenance log assuring UAS flight readiness.

- PIC in command restricts access to UAS flight area to approved persons.

- PIC informs site management and/or site ownership of UAS flight risks for people and property in the flight path.

- PIC does not fly a UAS that does not have a fail-safe mechanism to automatically return the UAS to its takeoff point in the event of a power failure.

- PIC checks the UAS altimeter reading relative to site ground level.

- PIC restricts all flights to VLOS and no higher than 400 feet above ground level (AGL).

- PIC provides weather forecast for flight site including wind speed. PIC restricts flights to times when wind speeds do not exceed 10 knots (11.5 mph) to avoid inability for safe flight, particularly at higher altitudes. Higher wind speeds can result in gusts, which may cause short periods of flight instability. In all instances, the PIC should not fly the UAS in wind speeds higher than recommended by the UAS manufacturer.

- Projects conduct all flights during daylight hours according to VFR rules with both a UAS trained pilot and VO who received training according to the SHSU UAS manual. SHSU UAS maintain fail-safe features to automatically and slowly return to the home point and land automatically in the event of an emergency.

- SHSU UAS maintain fail-safe features to automatically and slowly return to the home point and land automatically to assure aircraft safety in the event of Command and Control link failure. The SHSUPHY operations manual outlines risk factors for weather, obstacles in flight path, and unexpected events.

- Educational activities and educational outreach require the PIC teach an unlicensed individual the flight operational procedures for UAS before the individual or individuals obtain FAA certification. During training, only individuals who possess a current FAA third-class airman medical certificate or a valid U.S. driver's license issued by a state, the District of Columbia, Puerto Rico, a territory, a possession, or the Federal government will be permitted to operate the UAS. The properly certified PIC as well as a VO must stand alongside the student when an FAA uncertified student operates the aircraft.

- SHSU requires UASs operations below a 400 ft. altitude in specific restricted access areas in either Class G airspace or in airspace with APC permission using SHSU trained pilots in visual line of site for both the PIC and VO. These restrictions for operations cohere with the FAA limits of operations. The UAS employed by SHSU do not pose a safety threat to the National Air Space (NAS), ground personnel, or national security as they weigh less than 55 lb. and fly at speeds less than 100 mph below 400 ft. AGL.

- PIC maintains a manual outlining required procedures for safety, aircraft and systems inspection, and aircraft and systems maintenance.

- SHSU restricts UAS operations in Class G airspace to altitudes below 400 ft., five miles or greater from an airport or coordinated with ATC, and not without the consent of the property owner where flights are carried out.

- The PIC must have as a minimum conducted three takeoffs (launch) and three landings (recovery) in the UAS within the previous 90 days.

- Operations are during daylight hours, in a sparsely populated location, approved and conducted solely within VLOS in Class G airspace, conducted no further than 1/4NM-3/8NM laterally from the UAS PIC and at an altitude of no more than 400 feet AGL at all times, conducted no closer than 5 NM from any FAA-designated airport or heliport other than the airport from which the aircraft is operating, or conducted from a privately owned airfield, military installation, or off-airport location.

- An effective U.S. registration certificate issued to its owner or, for operation within the United States, the second copy of the Aircraft registration is required or a Certificate of Aircraft registration as provided in part 48, or a registration certification issued under the laws of a foreign country.

- PIC and VO(s) closely control and monitor flight operations to assure it operates in compliance with local public safety requirements.

- No person may operate a UAS unless it is in an airworthy condition. The PIC is responsible for determining whether the UAS is in condition for safe flight and shall discontinue the flight when unairworthy mechanical, electrical, or structural conditions occur.

  "The FAA provides information regarding the definition of the term "airworthy" in FAA Order 8130.2J, Airworthiness Certification of Aircraft and Related Products, Chapter 1." The FAA says specifically in Flight Standards Information Management System, 8900.1, as of June 28, 2016 "16-2-1-3 UAS AIRWORTHINESS. Before conducting any operations in the National Airspace System (NAS), an Unmanned Aircraft System (UAS) (public, civil or hobby/recreational), must be determined to be in a condition for safe operation without undue risk to other operations in the NAS, or to persons and/or property on the ground. It is the responsibility of the public entity to make this determination. How a UAS is authorized to conduct these operations establishes the means (or plays a role) by which airworthiness of the UAS is determined. The Federal Aviation Administration (FAA) recognizes that some of the requirements for public operations of UAS can differ from those for manned aircraft, and civil UAS operations."

- The UAS will not operate in populated or congested areas without prior approval. PIC will inform any involved property owner of the risks to people on the ground or property, planned flight path, and will only operate in the area with the approval of the property owner. The UAS will operate at a low altitude which will permit in the event of a power failure an emergency landing without significant risk to people or property on the ground. The PIC will set the return to home emergency feature to assure minimal risk to people and property on the ground. Therefore, the low altitude and low speed of the aircraft minimizes the risk to people and property on the ground.

- The UAS flies at altitudes below 400 ft. AGL and does not have to maintain altitudes to avoid conflict with other aircraft. The on board radio transmitter transmits the aircraft's current altitude above the takeoff point to the display screen held by the PIC and provides a continually updated AGL readout.

- The UAS has sufficient battery power to fly 25 minutes with a battery level indicator in the control app that turns red when the battery drops to 20% of fully charged to permit the PIC to safely return the aircraft to home. The aircraft will never fly further than 1/4NM-3/8NM from the intended landing point, and a fully charged battery assures sufficient reserve energy for safe return. These conditions provide the minimum airworthiness for safe flight.

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- The PIC will perform UAS inspection and maintenance with the authorization to return the aircraft to service. The Pre-Flight Checklist in Appendix A requires that the PIC conduct inspections regularly and before each flight to assure that the aircraft is airworthy for flight. The PIC does only limited maintenance such as propeller replacement, repairing small cracks, updating software and aircraft firmware, and checking electrical connections. All other maintenance will be performed by the UAS manufacturer or its appointed facility. The PIC will maintain complete records of maintenance and repairs.

- The PIC must hold a current FAA third-class airman medical certificate or a valid U.S. driver's license issued by a state, the District of Columbia, Puerto Rico, a territory, a possession, or the Federal government.

Appendix A
Flight Operations

All UAS operates with the following restrictions.

Flight Restrictions
UAS flight operations require both a Pilot in Command (PIC) and a Visual Observer (VO) for both pre-flight checks and flight. The following restrictions must be stringently followed.

1. No operations are permitted without the presence of both a PIC and a VO able to communicate by voice in pre-flight check and during flight.
2. The PIC must hold a current FAA issued UAS certificate and a current FAA third-class airman medical certificate or a valid U.S. driver's license issued by a state, the District of Columbia, Puerto Rico, a territory, a possession, or the Federal government.
3. The VO must hold a current FAA third-class airman medical certificate or a valid U.S. driver's license issued by a state, the District of Columbia, Puerto Rico, a territory, a possession, or the Federal government.
4. The PIC must have received training in the employed UAS and have as a minimum conducted three takeoffs (launch) and three landings (recovery) in the employed UAS within the previous 90 days.

5. The UAS will not fly over densely populated areas, open area assembly of people, or within 5NM of an airport or heliport without prior approval.
6. The PIC will thoroughly brief the property owner or property manager and VO for the planned flight and any associated risks.
7. The PIC must perform a pre-flight inspection before each flight to assure the UAS is in safe condition for operation.
8. All flights must be conducted in Class G airspace, at an airspeed less than 15 m/s, at no more than 400 ft. AGL, and no further than 1/4NM-3/8NM from the PIC.
9. All flights will be restricted to day light and weather conditions equivalent to VFR and when wind speeds do not exceed 10 knots (11.5 mph).

Pre-flight Checklist

PIC uses the manufacturer's pre-flight check list as follows verbatim.

1. Assure the Remote Controller, Smart Battery, Range Extender, and smartphone are fully charged.
2. Propellers are mounted correctly.
3. Gimbal clamp has been removed.
4. Damping absorbers are in good condition, not broken or worn.
5. Anti-drop kits have been mounted correctly.
6. Camera lens cap has been removed.
7. Micro-SD card has been inserted if necessary.
8. Gimbal is functioning as normal.
9. Motors can start and are functioning as normal.
10. The UAS App can connect to the camera.

Take Off and Landing Operations

PIC adheres to the manufacturer's Takeoff and Landing procedures as follows.

I. Flight Environment[1]

1. Do not use the aircraft in severe weather conditions These include wind speed exceeding 10 knots (11.5 mph), snow, rain and smog.
2. Fly in open fields as high buildings or steel structures may affect the accuracy of onboard compass.

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[1] DJI, *Phantom 2 Vision+ User Manual* V1.1 (Shenzhen, China: DJI, 2014), 37. A later version of the manual, *Phantom 2 Vision+ User Manual* (EN) V1.8 2015-01-30, is also available as a download at http://www.dji.com/product/phantom-2-vision-plus/info#downloads. Accessed January 28, 2016.

3. Keep the UAS away from obstacles, crowds, high voltage power lines, trees or bodies of when in flight.
4. Reduce the chance of electromagnetic interference by not flying in areas with high levels of electromagnetism, including base stations or radio transmission towers.
5. Do not fly the aircraft within no-fly zones specified by local laws and regulations.

II. Takeoff[2]

1. Choose the Takeoff/Landing area in an area free of concrete or metal. Otherwise, the Compass cannot be calibrated correctly, and the Failsafe mode will not function properly.
2. Calibrate the compass in every new location to set the Failsafe Mode following the UAS manufacturer's procedures. Refer to the manufacturer's instructions for calibrating the compass for more details.
3. Place the UAS on open flat ground with battery indicators facing towards you.
4. Set Remote Controller to Position switches according to the UAS manufacturer's guidelines.
5. Power on the Remote Controller and any associated Range Extender, then the onboard flight battery.
6. Launch the UAS App and bind it with your smartphone. Then enter its camera preview page.
7. When the GPS navigation system finds 6 or more GPS satellites the Flight Control System locks its home points and indicating aircraft may takeoff and follow normal flight.
8. Execute the joystick command to start motors.
9. Push the throttle up slowly to take off.

III. Landing[3]

1. To land, hover over a level surface, avoiding concrete or metal, and gently pull down on the throttle to descend.
2. After landing, execute the CSC command. The Pilot in Command can use one of two methods to stop the motors. In the first method, the PIC pushes the throttle down and executes the CSC command. In the second, the PIC pushes the throttle down and holds it down. The motors stop after 3 seconds.
3. Turn off the Smart Battery, Range Extender, and Remote Controller.

Failsafe Function

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[2] DJI, *Phantom 2 Vision+ User Manual* V1.1 (Shenzhen, China: DJI, 2014), 40. A later version of the manual, *Phantom 2 Vision+ User Manual* (EN) V1.8 2015-01-30, is also available as a download at http://www.dji.com/product/phantom-2-vision-plus/info#downloads. Accessed January 28, 2016.

[3] DJI, *Phantom 2 Vision+ User Manual* V1.1 (Shenzhen, China: DJI, 2014), 40. A later version of the manual, *Phantom 2 Vision+ User Manual* (EN) V1.8 2015-01-30, is also available as a download at http://www.dji.com/product/phantom-2-vision-plus/info#downloads. Accessed January 28, 2016.

When the Remote Controller loses connection with the DJI Phantom 2 Vision Plus in flight, the Failsafe mode takes over to automatically fly the aircraft to home to reduce the possibility of injury or damage. When the Rear LED Flight Indicator blinks yellow rapidly in flight, the aircraft has entered the Failsafe mode. When the Rear LED Flight Indicator slowly or rapidly blinks red during flight, a low battery level is indicated and the Pilot in Command should fly the aircraft back to home. The Failsafe mode will activate for the following situations.

1. The Remote Controller shuts off.
2. The aircraft flies beyond the communication range between the Remote Controller and the aircraft radio transmitter.
3. An obstacle between the Remote Controller and the aircraft interferes with communication.
4. Interference causes a problem with the remote controller.

Lost Communications

Any visual observer, sensor operator, or anyone else assigned the responsibility to provide collision avoidance must maintain communication with the UAS pilot. In the event communication between the observer, sensor operator or anyone else assigned the responsibility to provide collision avoidance loses communication with the UAS pilot, the UAS pilot will immediately return the UAS to Home point and land to avoid injury or damage.

Under no circumstances will the UAS pilot fly the UAS without first setting the Fail Safe mode and the GPS coordinates for the Home point. An observer will stand alongside the UAS pilot to monitor flight conditions using the DJI Phantom 2 Vision Plus DJI Vision App on the Smartphone. Should the DJI Vision App show the loss of GPS, low battery, or flight obstacles, the observer will inform the UAS Pilot without hesitation, and the UAS pilot will immediately return the UAS to Home point and land to avoid injury or damage.

When observers are stationed in other areas to visually monitor the UAS flight, the UAS pilot and the observer monitoring the DJI Vision App alongside the UAS pilot will maintain visual contact with them. Should the UAS pilot or the observer monitoring the DJI Vision App alongside the UAS pilot lose visual contact with any observer, the UAS pilot will immediately return the UAS to Home point and land to avoid injury or damage.

Under no circumstances will the UAS pilot operate the UAS outside VLOS. Should the UAS pilot or any observer lose UAS VLOS, the UAS pilot will immediately return the UAS to Home point and land to avoid injury or damage.

Lost Link Procedure(s)

The Phantom will enter Failsafe mode when its connection to the Remote Controller is lost. The Flight Control System will automatically control the aircraft to return to home and land to prevent injury or damage.

Home Point: When the Phantom enters 'Ready to Fly' from the 'Ready to Fly status (non-GPS)', the GPS coordinates will be recorded and set as the Home point.

- When Remote Controller signal is lost, the aircraft will return to the recorded Home point coordinates and land.
- Home point coordinates are used to calculate the horizontal distance of the aircraft (shown as "Distance" on the GUI of the DJI Vision App).
- After successfully recording the home point, rear LED flight indicators blink fast green. Dynamic Home Point: The Home point will be reset to position of the mobile device at specific time intervals.
- Enable dynamic Home point in DJI Vision app or Phantom 2 Assistant.
- Dynamic Home point is only available to the GPS-enabled mobile device. Turn on GPS and data service to obtain higher accuracy of the mobile device position.
- Dynamic Home point is useful in situations when you are in motion and require a Home point that is different from the takeoff point.

When Will Failsafe Activate?
1. The Remote Controller is powered off.
2. The Phantom has flown out of effective remote controller range.
3. The signal between the Remote Controller and the Phantom has been blocked.
4. There is interference causing a signal problem with the Remote Controller.

Failsafe Procedure

Initiating the Failsafe mode from different flying statuses will result in different landing processes.

Ready to Fly (non-GPS) – Automatic landing

The Flight Control System will keep the aircraft level during descent and landing. It may drift during the descent and landing process.

Ready to Fly – Automatic go home and land

The Flight Control System will automatically control the aircraft to fly back to the Home point and land.

Caution:

- To insure the aircraft's successful return to home after Failsafe activation, aim to fly in Ready to Fly mode.
- The Phantom will automatically descend during the Failsafe process if there are less than 6 GPS satellites detected for more than 20 seconds.
- When the aircraft is landing automatically, users can control the aircraft's position and altitude if the remote controller signal is recovered.
- Aircraft cannot navigate around vertical obstacles on its return home course during Failsafe. However, you can set return home altitude value in Phantom assistance to avoid hitting vertical obstacles through DJI Phantom Assistant.

Note: Quickly flipping the S2 switch of the Remote Controller from top to bottom 5 times or more will reset the current aircraft position as a new Home point. Rear LED flight indicators will blink green rapidly when successful.

How to regain control:

- When the S1 switch is switched to Position-1, toggle the S1 switch to any other position once to regain control. If the Remote Controller signal is recovered, control is returned to the pilot.
- Regain control as soon as signal is recovered.

Low Battery Level Warning Function

If the DJI smart battery is depleted to a point that may affect the safe return of the aircraft, the low battery level warning notifies users to take action. Users are advised to land the aircraft immediately when they observe these warnings. The thresholds for these warnings are automatically determined based on the current aircraft altitude and its distance from the Home point.

When these warnings are triggered, please bring the aircraft back to the Home point or land to avoid losing power during flight."[4]

Appendix B
User Manuals

The DJI Phantom 2 Vision Plus user manual may be downloaded at http://www.dji.com/product/phantom-2-vision-plus/info#downloads. The DJI Phantom 2 Vision + User Manual V1.1 contains the procedures for aircraft inspection, maintenance, pre-flight check, flight operations, and emergency procedures. The manual can be provided on request.

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[4] DJI, *DJI Phantom 2 Vision + User Manual* v. 1.8, 27-28. http://www.dji.com/product/phantom-2-vision-plus/download. Accessed June 16, 2015.