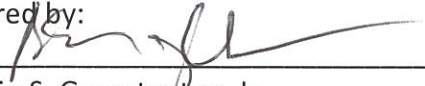
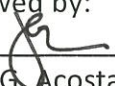
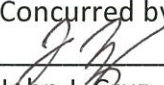
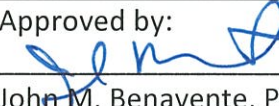


<p align="center">GUAM POWER AUTHORITY STANDARD OPERATING PROCEDURE</p>	<p>Prepared by:  Antonio S. Gumataotao, Jr. GIS/Rights of Way Supervisor</p>
<p>TITLE: OPERATION AND MAINTENANCE OF UNMANNED AERIAL VEHICLE (UAV)</p>	<p>Reviewed by:  Joven G. Acosta, P.E. Manager of Engineering</p>
<p>SOP No: 104 Supersedes:</p>	<p>Concurred by:  / <u>8-11-16</u> John J. Cruz, P.E. Date AGMETS</p>
<p>Page 1 of 10</p>	<p>Approved by:  / <u>8/2/18</u> John M. Benavente, P.E. Date General Manager</p>

1. PURPOSE

This Standard Operating Procedure (SOP) is provided to establish guidelines for the safe and efficient operation of GPA's Unmanned Aerial Vehicle (UAV). The UAV will be used to capture imagery and raster data to be distributed for consumption by GPA. The safe and efficient operation of the UAV will provide an additional tool to gauge operational performance, identify problem areas, address effective preventive maintenance, and plan for system improvements through imagery, photogrammetry and raster data. Due to the complexity, limited battery life, and time consuming nature of operating the UAV, at this time, the UAV is NOT designed to replace T&D hot line image capturing activities; rather, use of the UAV will supplement hot line image capture in difficult and hard to reach areas for efficient operations.

2. SCOPE

This standard operating procedure shall apply to all Engineering Units of the Authority which consist of Real Estate-GIS, Substation & Transmission, Customer Services-Eng, Distribution and Project Management. The Engineering Division is responsible for performing photogrammetry and raster data collection utilizing the unmanned aerial vehicle. Engineering shall initiate the planning and execution of the capture, production and distribution of imagery, photogrammetry and video for GPA projects. Engineering shall also interpret the imagery findings and make final recommendations to mitigate the cause of the discrepancies found (if any) relative to data captured from the UAV.

3. OBJECTIVE

This SOP is intended to ensure safe and efficient operations of the UAV to prevent injury to GPA personnel and the public. The safe and efficient operation will also provide GPA the most return on its investment through known best practices in utility infrastructure imagery and photogrammetry data capture operations. Additionally, the SOP will ensure compliance with known local and federal policies relative to unmanned aerial vehicle operations.

4. PROCEDURES

4.1 RESPONSIBLE AIRCRAFT OPERATIONS

- Pilot, Co-Pilot shall utilize Personal Protective Equipment (PPE) that consists of Hard Hat, Eye protection, Reflective Vest, iPad hood and landing pad at all times when operating the aircraft.
- Personnel within 20 feet of the landing pad shall also utilize PPE that includes Hard Hat and Eye Protection.
- For any UAV operations, a minimum of 2 personnel that consists of a Pilot (Aircraft operator) and a Co-Pilot (Camera operator and spotter) shall be assigned.
- Pilot shall have been sufficiently trained before flight operations and fully aware of any contingency plans.
- Pilot and Co-Pilot shall have a flight plan to include a contingency plan.
- The operators of the UAV shall respect the privacy of others when using the camera and ensure compliance with local privacy laws, regulations, and moral standards.
- The UAV shall only be used for official GPA business and shall NOT trespass into private property unless permission is granted by the property owner.

4.2 ENVIRONMENTAL CONSIDERATIONS and WEATHER

- Pilot shall NOT fly aircraft with wind speeds exceeding 10 meters per second (based on data from the Guam National Weather Service), in rain, heavy wind, lightning or Tropical Storm/Typhoon conditions.
- Pilot shall always fly at locations that are clear of building and other obstacles keeping the aircraft at least 30 feet away from obstacles when in flight and increase the distance as altitude increases.
- Pilot shall NOT fly above or near large crowds and indoors.
- Pilot shall NOT fly at altitudes above 400 feet (120m).
- Pilot shall NOT fly in weather conditions with temperatures that exceed 104° F.
- Pilot shall NOT utilize Vision Positioning System mode when flying over water or in low light environment.

4.3 PRE-FLIGHT CHECKLIST

- Pilot/Co-Pilot shall ensure the remote controller, aircraft batteries and mobile device are fully charged.
- Pilot shall ensure the propellers are in good condition and securely tightened.
- Pilot shall ensure there is nothing obstructing the motors.
- Co-Pilot shall check and ensure that the camera lens is clean and free of stains.
- Pilot/Co-Pilot shall follow on-screen instructions to calibrate compass and only calibrate the compass when the DJI GO app or the status indicator prompts to do so.
- Co-Pilot shall ensure that there is no foreign object stuck to camera lens, the micro SD card has been inserted into the camera, and the gimbal can rotate freely before powering it on.
- Pilot/Co-Pilot shall ensure the app and Aircraft's firmware have been upgraded to the latest version.
- Pilot/Co-Pilot shall ensure that flight area is outside the No-Fly Zone and flight conditions are suitable for flying the aircraft.
- Pilot/Co-Pilot shall NOT fly under the influence of alcohol, drugs or any substance that may impair their cognitive abilities.
- Pilot/Co-Pilot shall be familiar with the selected flight mode and understand all safety functions and warnings.
- Pilot/Co-Pilot shall observe all local regulations, obtain appropriate authorizations, and understands the risks. REMEMBER: It is solely the Pilot's responsibility to comply with all flight regulations.
- Pilot/Co-Pilot shall choose an appropriate terrain when trying to use the Vision Positioning System to stabilize the aircraft.

4.4 OPERATION

- Pilot/Co-Pilot shall ensure all personnel are clear from rotating propellers and motors.
- Pilot/Co-Pilot shall maintain line of sight of the GPA UAV at all times in accordance with FAA regulations.
- Pilot shall NOT perform Combination Stick Command when the aircraft is in midair.
- Pilot/Co-Pilot shall NOT fly under the influence of alcohol or drugs.
- Pilot shall adjust altitude to avoid obstacles during the Return-to-Home procedure.
- Pilot shall NOT fly closely above reflective surfaces such as water, as these terrains may affect the performance of the Vision Positioning System.
- Pilot shall land the aircraft as soon as possible at a safe location in the instance of a Low Battery Warning.

- Pilot shall always keep their hands on the remote controller so long as the motor is still spinning. Pilot shall power off the aircraft before turning off the remote controller after landing.

4.5 INTERFERENCE with FLIGHT CONTROLLER, COMMUNICATIONS, and POSITIONING SYSTEMS

- Pilot shall fly in open areas. Tall buildings of steel structure may affect the accuracy of on-board compass and block the GPS signal.
- Pilot/Co-Pilot shall avoid interference between the remote controller and other wireless equipment. Make sure to turn off the Wi-Fi on the mobile device.
- Pilot/Co-Pilot shall be wary of flying near areas with magnetic or radio interference that may compromise transmission quality or cause remote controller and video transmission errors. If aircraft behaves abnormally or go out of control, there may be too much interference and Pilot shall land in a safe place as soon as possible.

4.6 FLIGHT MODES

- Pilot/Co-Pilot shall make every attempt to perform flight operations in P mode and with strong GPS signal.
- P Mode (Positioning):
- -P-GPS: GPS and Vision Positioning are both available and the aircraft uses GPS for positioning.
- -P-OPTI: If GPS is NOT available, the aircraft will use Vision Positioning System to hover accurately. VPS may not work accurately when operating over water or in low light environment.
- -P-ATTI: When neither the GPS nor the Vision Positioning System is available, the aircraft is using only its barometer for positioning, so only altitude is controlled.
- Pilot/Co-Pilot will only utilize A mode when all other options to utilize P mode has been exhausted and is necessary to complete the objective.
- -A mode (Altitude): The GPS and Vision Positioning System are NOT used for positioning. The aircraft only uses its barometer to maintain altitude. If it is still receiving a GPS signal, the aircraft can automatically return home if the Remote Controller signal is lost and if the Home Point has been recorded successfully.
- Pilot/Co-Pilot will only utilize F mode when all other options to utilize P mode and A mode has been exhausted and is necessary to complete the objective.
- -F mode (Function): Intelligent Flight is activated in this mode. Pilot shall ensure familiarity with Intelligent functions before use.

- Pilot/Co-Pilot shall NOT switch from P mode to either A mode or F mode unless Pilot is sufficiently familiar with the aircraft's behavior for each flight mode.

4.7 FAILSAFE and RETURN to HOME

- Pilot shall verify P mode to ensure that the Return to Home feature will work if the GPS signal is sufficient.
- Pilot shall utilize and press the RTH (Return to Home) Button on the remote controller to bring the aircraft back to the Home Point instead of turning off the remote controller.
- Pilot shall avoid flying near tall buildings as it may adversely affect the Failsafe function. Pilot shall adjust aircraft location, altitude and speed while returning home to avoid obstacles.
- Pilot shall always fly the aircraft within the transmission range of the remote controller.
- Pilot shall NOT block GPS signal of the remote controller and ensure the new Home Point is correct on the live map when updating the Home Point.
- Pilot shall NOT update the Home Point near tall buildings, as the GPS may be blocked and lead to an incorrect location being stored.
- Pilot shall only use the Failsafe and Return to Home functions in case of emergency, as they may be affected by the weather, the environment, or any nearby magnetic fields.
- Pilot shall set an appropriate Failsafe altitude before each flight as the aircraft cannot avoid obstacles during the Failsafe RTH.

4.8 LOW BATTERY

- When the Critical Battery Level Warning activates and the aircraft is descending automatically, the Pilot shall push the throttle up to maintain the aircraft's altitude and navigate it to a more appropriate location for landing.
- When battery warnings are triggered, Pilot shall promptly bring the aircraft back to the Home Point or land to avoid losing power during flight.

4.9 TRANSFORMATION FUNCTION

- Pilot shall ensure that aircraft is clear of all obstructions when performing the Transformation Function.
- At no time will the Pilot allow anyone to catch or hold the aircraft, as the landing gear will lower if the Vision Positioning System detects an object and may cause injury.
- Pilot shall ensure the landing gear is lowered before landing and that the landing pad is deployed.

4.10 VISION POSITIONING SYSTEM

- Pilot shall fly using the Vision Positioning System mode in the effective altitude for the Vision Positioning System to function correctly is less than 9.8 feet above ground level (AGL).
- Pilot shall avoid flying over water as the Vision Positioning System may NOT function properly when aircraft is flying over water.
- Pilot shall avoid flying too fast or too low because the Vision Positioning System may NOT function properly when aircraft is flying too fast or too low.
- Pilot shall be cautious of the Vision Positioning System when operating in any of the following conditions:
 - -Flying over monochrome surfaces (pure black, pure white, pure red, pure green)
 - -Flying over highly reflective surfaces.
 - -Flying over water or transparent surfaces.
 - -Flying over moving objects.
 - -Flying over an area where lighting changes frequently or drastically.
 - -Flying over extremely dark or bright surfaces.
- Pilot shall understand that in the event of loss of the remote controller's signal, the aircraft will hover for 8 seconds and then auto-land if it is in "P" mode.

4.11 OBSERVE LOCAL LAWS AND REGULATIONS

- Pilot shall NOT fly in No Fly Zones unless Pilot possesses an FAA certificate and permission has been granted under FAA, local laws and permission of the landowner. No Fly Zones can be located at <http://flysafe.dji.com/>. DJI No fly zone does not replace FAA, local government regulations or good judgment.
- Pilot shall NOT operate in the vicinity of manned aircraft, regardless of altitude. (Pilot shall land aircraft immediately if necessary)
- Pilot shall always keep aircraft within visual line of sight (VLOS) and Co-Pilot will act as observer/spotter.
- Pilot shall avoid flying in areas where rescue teams are actively using the airspace.

4.12 MAINTENANCE AND UPKEEP

- Pilot/Co-Pilot shall NOT use aged, chipped or broken propellers.
- UAV shall be stored in the GPA Engineering GIS Mapping Room. If deployed, ensure storage between 71° and 82° F and in ruggedized transportation case.

- Pilot/Co-Pilot shall refer to the Intelligent Flight Battery Safety Guidelines for more information about the safe use of the battery. (See Attachment A)
- Pilot/Co-Pilot shall check every part of the aircraft after any crash or violent impact. Regularly check the Battery Level Indicators to see the current battery level and overall battery life.
- Pilot/Co-Pilot shall NOT apply lubricants to aircraft arms. Keep aircraft arms clean.

4.13 REMOTE CONTROLLER

- Pilot/Co-Pilot shall ensure the remote controller is fully charged before each flight.
- Pilot/Co-Pilot shall ensure the mobile device is securely attached to the remote controller and antennas of the remote controller are unfolded and adjusted to the proper position to achieve optimal transmission quality.
- Pilot/Co-Pilot shall ensure linkage is established between the remote controller, aircraft and mobile device and the latest firmware and DJI app are installed.
- Pilot/Co-Pilot shall ensure that a secondary remote controller is NOT linked with the aircraft and cannot control the aircraft's flight. The Primary remote controller, operated by the Pilot, will utilize the latest DJI app for aircraft flight control. The Secondary remote controller, operated by the Co-Pilot, will control the payload/camera operations.
- Pilot/Co-Pilot shall ensure the DJI logo is facing the sky and keep remote away from metal objects for optimal performance in GPS mode and the Dynamic Home Point accuracy.

4.14 CAMERA

- Co-Pilot shall check the camera settings before use to make sure it can adjust to fit the needs of the objective.
- Co-Pilot shall test the camera by shooting a few test images and check that it is operating correctly before shooting important images or videos.
- Co-Pilot shall NOT remove the micro-SD card from the camera when it is powered on.
- Images or videos cannot be transmitted or copied from the camera if the Intelligent Flight Battery is powered off.
- Co-Pilot shall ensure to power off the Intelligent Flight Battery correctly, otherwise the camera parameters will NOT be saved and any recorded videos may be damaged.

4.15 GIMBAL

- Pilot/Co-Pilot shall NOT apply external force to the gimbal after the gimbal is powered on.

- Pilot/Co-Pilot shall NOT add any payloads to the gimbal (other than Zenmuse X5 or the Zenmuse XT), as this may cause the gimbal to function abnormally or even lead to motor damage.
- Pilot/Co-Pilot shall remove the gimbal clamp before powering on the gimbal. Re-install the gimbal clamp to secure the gimbal's position if the aircraft will be stored for an extended period.
- Pilot/Co-Pilot shall NOT touch the gimbal connector and only hold the gimbal firmly when detaching or reattaching it.

4.16 COMPASS

- Pilot/Co-Pilot shall land the aircraft immediately when severe drifting occurs in flight or if aircraft does NOT fly in straight lines.
- Pilot/Co-Pilot shall only calibrate the compass when the DJI GO app or the status indicator prompts to do so.
- Pilot/Co-Pilot shall NOT calibrate the compass where there is a chance of strong magnetic interference, such as magnetite, parking structures, and steel reinforcements underground.
- Pilot/Co-Pilot shall NOT carry ferromagnetic materials during calibration such as cellular phones.
- When the DJI GO app prompts to resolve the compass issue if the compass is affected by strong interference after calibration is complete, Pilot/Co-Pilot shall ensure that instructions are followed to resolve compass issue.

4.17 PROPULSION SYSTEMS

- PROPELLERS
 - Pilot/Co-Pilot shall NOT use aged, chipped, or broken propellers.
 - Pilot/Co-Pilot shall always power off the aircraft before touching the propellers.
 - Pilot/Co-Pilot shall be aware of the sharp edges of the propellers when mounting or removing the propellers. Wear gloves or take other protective measures when touching the propellers.
 - Pilot/Co-Pilot shall, whenever necessary, use tools (e.g. wrench, screwdriver, pliers, etc.) to remove or install the propellers.
- MOTORS
 - Pilot/Co-Pilot shall ensure the motors are securely mounted and rotating smoothly.
 - Pilot/Co-Pilot shall NOT attempt to modify the structure of the motors.
 - Pilot/Co-Pilot shall NOT touch or let hands or body come in contact with the motors after flight as they may be hot.
 - Pilot/Co-Pilot shall keep motors free of dust. If a motor is stuck or unable to rotate freely, execute the Combination Stick Command to stop the motors immediately.

- Pilot/Co-Pilot shall ensure the Electronic Speed Controllers sound a normal tune when powered on.

4.18 APP

- Pilot/Co-Pilot shall ensure to fully charge the tablet or mobile device before launching the app.
- Pilot/Co-Pilot shall ensure mobile phone is NOT used to control the aircraft for flight operations as to avoid distractions from incoming calls.
- Pilot/Co-Pilot shall read all prompted safety tips, warning messages, and disclaimers carefully.
- - Pilot/Co-Pilot shall read and understand the warning messages before using the Auto-take off and Auto-land feature.
- - Pilot/Co-Pilot shall read and understand the warning messages before re-setting the Home Point.
- - Pilot/Co-Pilot shall read and understand the warning messages and disclaimer before switching between the flights modes.
- Pilot/Co-Pilot shall land the aircraft immediately if there is an alert shown on the app.
- Pilot/Co-Pilot shall examine and check all warning messages on the checklist displayed in the app prior to each flight.
- Pilot/Co-Pilot shall use the in-app simulator to practice flight skills if they have never operated the aircraft or if they do not have sufficient experience to be comfortable operating the aircraft.
- Pilot/Co-Pilot shall use the beginner Mode when launching the app for the first time and SHALL be used when flying in an area not previously flown. The aircraft's altitude and flight distance is restricted.
- Pilot/Co-Pilot shall, when possible, cache the map data of the area intended to fly the aircraft with internet connection before each flight.

4.19 FIRMWARE

- Pilot/Co-Pilot shall always update the firmware to the latest version when an upgrade notification is shown in the app.
- Pilot/Co-Pilot shall verify firmware upgrade notifications will inform about new firmware upgrades. Pilot/Co-Pilot are required to read and understand the information shown to include flight telemetry data and use selection records to be uploaded and maintained on DJI-designated server.
- Pilot/Co-Pilot shall ensure to download the firmware package file from the official DJI website. Verify the firmware package file's integrity before upgrading.
- Pilot/Co-Pilot shall ensure to update the remote controller's firmware to the latest version after the aircraft's firmware has been updated.

- Pilot/Co-Pilot shall verify to determine if the remote controller has become unlinked from the aircraft after updating. If so, re-link the remote controller and aircraft.
- Pilot/Co-Pilot shall check all connections and remove the propellers from the motors before performing the firmware update.
- Pilot/Co-Pilot shall ensure there is only one firmware package file stored on the SD card.
- Pilot/Co-Pilot shall only utilize storage devices that are formatted for FAT32 and exFAT file systems are supported for aircraft and remote controller firmware updates.

4.20 STORAGE AND TRANSPORTATION

- Pilot/Co-Pilot shall store aircraft, remote controller and iPads in ruggedized case and in GPA GIS Mapping Room when not in use.
- Pilot/Co-Pilot shall store the Intelligent Flight Battery and remote controller in a cool dry place away from direct sunlight.
- Pilot/Co-Pilot shall NOT allow the camera to come into contact with, or become immersed in, water or other liquids. If it gets wet, wipe dry with a soft, absorbent cloth. Do not turn on an aircraft that has fallen into water.
- Pilot/Co-Pilot shall NOT use substances containing alcohol, benzene, thinners or other flammable substances to clean or maintain the camera. Do NOT store the camera in humid or dusty areas.
- Pilot/Co-Pilot shall detach the gimbal from the aircraft when storing for a long period of time or transporting over long distances. Also replace the Gimbal Clamp and Gimbal Cover when storing.
- Pilot/Co-Pilot shall NOT connect this product to any USB interface that is older than version 2.0. Do NOT connect this product to any "power USB" or similar devices.
