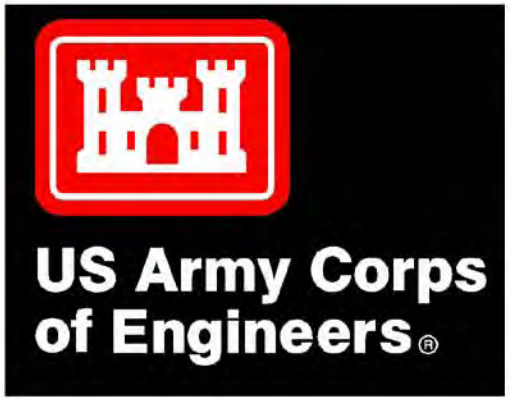
FEMA

FEMA Region IV UAS Strategy

Remote Sensing Platform Cost Examples

4285DR-NC-USAF-01 $80,000



South Carolina Flooding $23,000

$25 Hourly

Small Prop Vs. Large Prop Vs. Big Eye

$$$$$$$

$$$$$

$$$

400 Feet

$

$

Some public service agencies potentially not in compliance with FAA regulations?

[redacted]
Fire Chief

[redacted] FIRE DEPARTMENT

"Fire departments around the world are discovering how drones can change the way we put out fires. Dronelife believes there should be firefighter drones in every station" – Dronelife.com

[redacted]
Fire Chief

[redacted] FIRE DEPARTMENT

FEMA Region IV UAS

"There are 27,216 fire departments listed with the National Fire Department Registry. This is about 91 percent of all U.S. fire departments. Registration for the list is voluntary." – U.S. Fire Administration

[redacted]
Fire Chief

[redacted] FIRE DEPARTMENT

FEMA Region IV UAS

"Drones are also becoming an increasingly common holiday purchase, with sales jumping 445% in the 2015 holiday season. Sales are expected to grow from 2.5 million drones in 2016 to 7 million in 2020—a 180% increase, according to a report from the Federal Aviation Administration." May 25, 2016 – Fortune.com

[redacted]
Fire Chief

[redacted] FIRE DEPARTMENT

Challenges

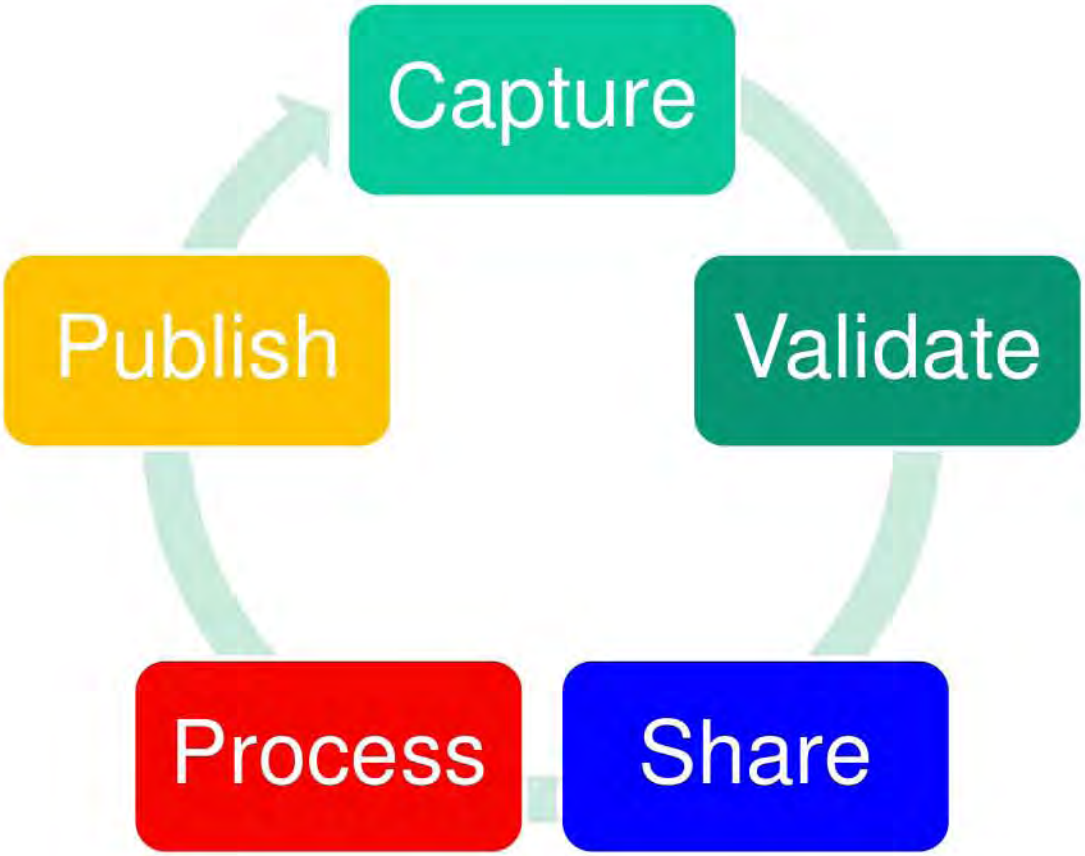
Imagery working group formed to address imagery inconsistency.

FEMA Region IV UAS

Digital imagery working group formed to address UAS imagery standards.

FEMA Region IV UAS

Working Group Collaborative Efforts



Reimbursement for UAS Aerial Photography

1. Under Category B, the Grantee can request reimbursement on behalf of the Subgrantee if drones were used to find areas that were heavily impacted and require immediate attention to prevent a threat to life and safety. FEMA will pay the Grantee who should then reimburse the Subgrantee for those costs. (Response)

2. The Grantee can pay for drone aerial photography using the disaster management cost funds. (Recovery)

Source: FEMA Recovery Division

Partnerships

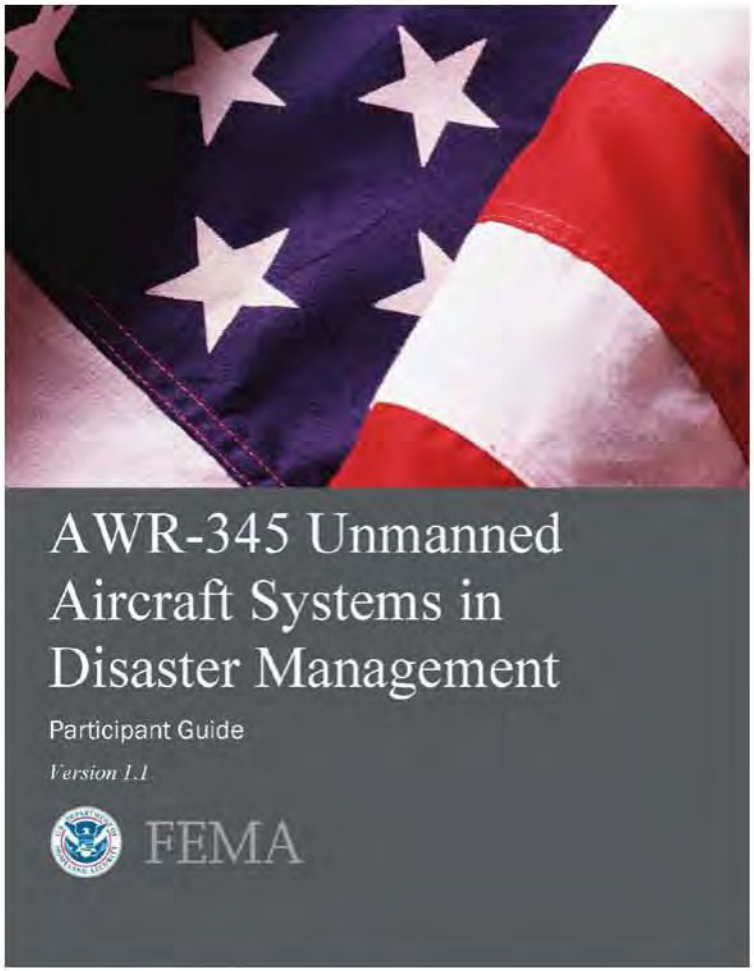
Regulator (Section 333, 14 CFR Part 107)

Encourager (NOAA UAS Trusted Agent Program)

FEMA

Validator, Coordinator, Reimbursor
(UAS Working Groups)

FEMA as Validator



FEMA National Integration Center Resource Typing Definition for Response Situational Assessment Effort

UNMANNED AERIAL SYSTEM TEAM, FEMA-508-v20170717

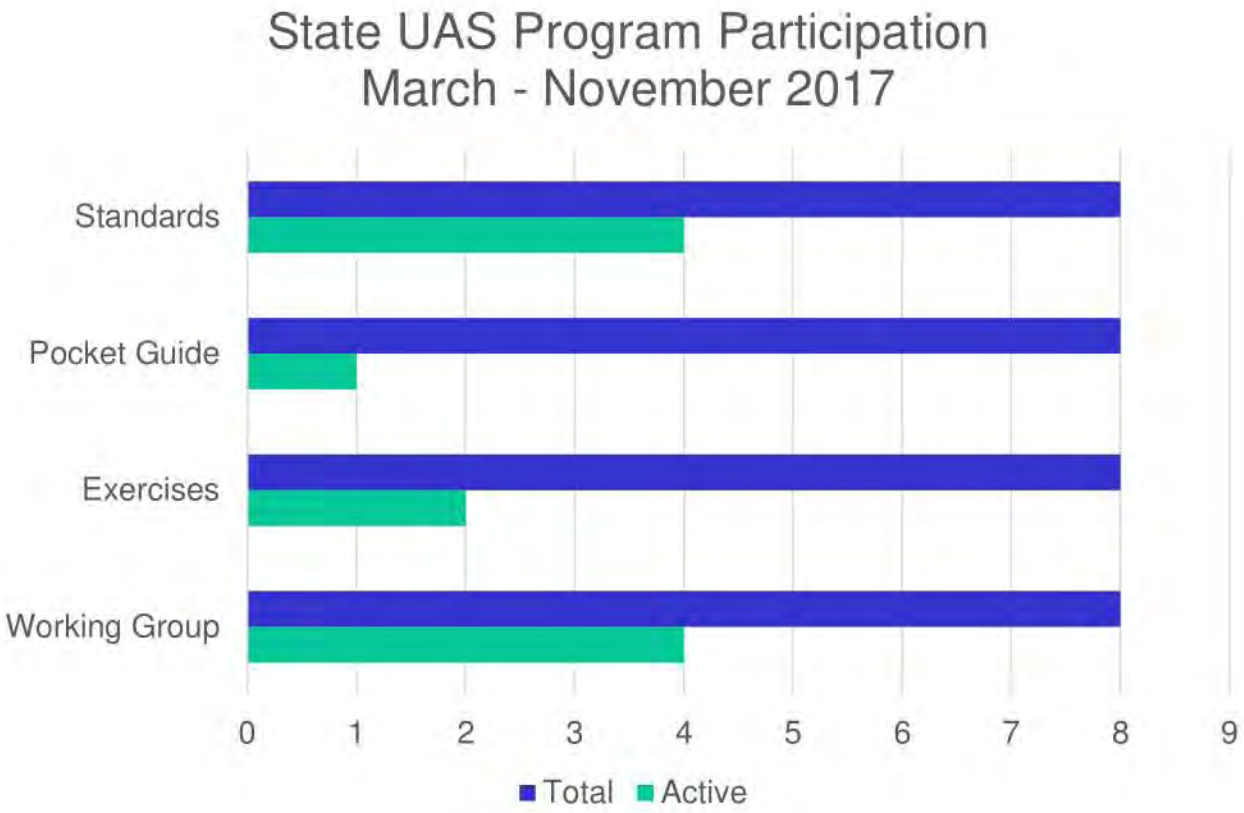
PILOT-IN-COMMAND–UNMANNED AERIAL SYSTEM, FEMA-509-v20170717

TECHNICAL SPECIALIST–UNMANNED AERIAL SYSTEM, FEMA-509-v20170717

SEPTEMBER 2017

Success Stories

Region IV UAS



UAS Activity During Nate, Irma, and Harvey

The imagery standards developed by the working groups were adopted and used by UAS teams during these events.

The FAA issued more UAS waivers than during any other previous period for emergency response efforts.

A Delaware PDA team with UAS capability was EMAC'd to Florida to do damage assessments.

Upcoming Region IV UAS Working Group Kick-Offs

Alabama - December 11th, Huntsville

North Carolina – January 2018

FEMA

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SUMMARY OF "WHITE PAPER ON THE USE

OF UAVS WITHIN FEMA"

Abstract: This paper is a summary of the paper "White Paper on the Use of UAVs within FEMA" that was written in August of 2016. This summary will be addressing the benefits of UAS over traditional methods, the increase of agencies using the technology, challenges to implementation, and recommendations for FEMA.

Introduction

While the Federal Emergency Management Agency (FEMA) does not plan on developing an internal unmanned aircraft systems (UAS) program, the agency has previously tasked other federal agencies (such as USACE and CBP) to conduct UAS operations for previous events. In order to remain flexible for future events, FEMA, may once again leverage this option for future events, should the need arise or based on mission requirements.

Benefits

UAS is considerably cheaper and can range anywhere between $100 to $5,000 for a small unmanned system compared to manned aviation which can cost between $500,000 and $4 million to acquire the aircraft, not counting the amount per hour to man the unit. Because of UAS's relatively low cost, compared to manned aviation, UAS are more expendable. They are able to do riskier missions such as monitoring hazardous materials or flying into bad weather conditions without a significant risk to investments as well as no risk to life since there is no onboard crew. Along with cost, UAS are able to fly closer to the ground than regular manned aviation. This can be significant when weather is poor and there is cloud cover because a small UAS is able to fly below the cloud cover without it disturbing the imagery collected, whereas manned aviation it would significantly impact the imagery. In the same idea, because UAS are able to get closer to the ground, the imagery can be more detailed than manned aviation and easier to download after a mission is flown. The data acquisition from a UAS is faster since all of the imagery is downloaded on an SD card that is put directly inside the system. This makes it fast and easy to download the imagery right away. UAS are also able to fly semi-autonomous missions, and are working toward fully-autonomous missions. This means that a flight path can be mapped out prior to the flight along with the amount of coverage and length of time for the mission.

Capabilities

One of the most frequent use of UAS at any level of government has been for urban search and rescue (USAR) missions. There have been a number of examples of the systems use in these cases including the Virginia Key, Florida Drone Exercise in 2016, the 2015 Wimberley Flood, the Florida Statewide Hurricane Exercise 2016, etc. Currently a Standard Operating Procedure (SOP) is being created by the Department of Homeland Security, Department of Defense,

Department of State, US Coast Guard, and many others for USAR operations. This guide is not yet currently available but covers issues such as air space deconfliction as well as the history and different types of UAS.

Another popular use of UAS is mapping and reconnaissance. This process involves using the data produced by the UAS to create orthophotos, aerial maps, which can be accurately laid over an existing map to give first responders a better sense of the area. This has also been used in humanitarian efforts for planning for hazardous events and mapping flooded areas in countries such as Tanzania.

The use of UAS has also been explored in other areas such as showing the condition of traffic flow on evacuation routes, indicators of approaching hazards, risk assessments, long-term recovery efforts, wildfire assessment and monitoring, etc.

Challenges

Some of the challenges to implementing UAS in a disaster scenario include the public's perception of UAS especially in concerns of ensuring privacy and rights, the Federal Aviation Administration (FAA) and local flight approvals, integration into national airspace, and the need of training and team exercises. With that brings up needing a contact list, since FEMA does not employ their own systems, it is important to have a working contact and resource list as well as an updated Air Operations Guide. Another challenge that has proved to be a problem in the UAS world is the issue of spontaneous UAS pilots. This can prove to be a problem for first responders and may inhibit life-saving actions, as seen in the 2015 Lake Fire in California. Memorandums of Understanding (MOUs) can also pose to be a potential challenge as even though FEMA would not be personally responsible for obtaining a COA, FEMA would be liable for if an accident happens while another agency is flying.

Recommendations

Recommendations for ensuring safe and efficient UAS use include: creating a Standard Operating Procedure and Guide that outlines many safety standards and regulations, creating a contact list (complete with resources), promoting a standardized training specifically made for emergency management responders (like the one created by the University of Hawaii that is a FEMA course), and finally, addressing the issue of spontaneous pilots by working with Volunteer Organizations Active in Disaster (VOAD). It is also recommended that FEMA develop a working group with the regional offices in order to best promote safe and effective flying at the state and local level.

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Keywords: UAV, unmanned, unmanned aerial vehicle, UAS, FEMA, DHS, Homeland Security
Summary of "White Paper on the use of UAVs within FEMA"

WHITE PAPER ON THE USE OF UAVS WITHIN FEMA

Abstract: *Recently the interest in using unmanned aerial vehicles (UAVs) has increased at the local, state, and federal level. Many regulations put out by the Federal Aviation Administration (FAA) placed restrictions on the use of UAVs by the government. Because of these regulations, it has become harder and more exclusive for certain government agencies to be able to use UAVs. This is especially true at the federal level. The use of UAVs are mainly restricted to the local and state emergency management agencies and currently not available to the Federal Emergency Management Agency (FEMA), outside of research and development. It would be in FEMA's best interest to address certain parameters in order to effectively use UAVs in disaster management, such as creating a contact list of government agencies, an air operations guide, addressing spontaneous volunteers, creating a training program, identifying legal and financial obligations, identifying mission capabilities, and addressing the idea of a blanket Certificate of Authorization (COA).*

**The terms in bold are hyperlinks to a definitions list.*

Introduction

In order to best understand the topic at hand, this paper will begin with a description of the different types of unmanned aerial vehicles and crew makeup, followed by current uses, research, and organizations that are using UAVs well. There are a number of discussion topics that need to be addressed in order for FEMA to utilize UAVs to their full potential which is also outlined in this paper. Currently, FEMA, and many other emergency management agencies, use manned aviation to collect data that is then used to give the decision makers of the agency firsthand information. However, as important as this is, there is another way to do it that is cheaper and more effective. UAVs are able to fly under cloud cover and get closer to the ground than manned aviation while being less expensive and aggregating just as accurate, if not more accurate, data. Also, because UAVs are less expensive and there is no risk of life for flying the systems, UAVs are more expendable than manned aviation. Therefore, the systems are able to go into areas to get information that normally would be restricted. UAVs also provide end products that manned aviation is not capable of doing such as creating a 3D Point Cloud. A Point Cloud is a 3D representation of an object and is very simple. This type of representation contains a set of (x, y, z) coordinates making the image 3D rather than 2D like other aerial photos.[1]

FEMA does not own or directly operate Unmanned Aerial Systems. FEMA has, and will, mission assign other Federal partners to utilize UAS and other aerial platforms to assist with infrastructure damage assessment.

UAV Description

In terms of using **UAV** for disaster management situations, there are two main types: fixed wing and rotary wing.[2] A fixed wing UAV is most

[1] (INF 555: Geometric Modeling: Digital Representation and Analysis of Shapes)

[2] (Murphy, 2014, p. 111)

practical for wide-area operational environments and missions, such as geological and meteorological surveys. These systems can fly between 45 to 120 meters in altitude.[3] A rotary wing UAV is ideal for local-area environments or when it is crucial for the UAV to get close to a structure. Other than the mission types, the main difference between a fixed wing and a rotary wing UAV is endurance, or the length of sustained flight. A fixed wing UAV can stay in the air for up to an hour, depending on weather, and is hand-launched. A rotary wing UAV has a much shorter endurance and can only stay in the air for 15-25 minutes depending on the make, model, and payload.[4] These factors will be important to remember when discussing resources needed for and the phase of a disaster.

Along with different types of UAVs, there are also two different sizes associated with emergency management uses: small and micro. Although there are medium and large UAVs, it is in FEMA's best interest to learn how to implement small and micro UAVs as the systems are easier to pilot, more affordable, and a more efficient training process. Compared to their larger cousins, small and micro UAVs are able to get closer to the ground, which is important for damage assessments and identifying potential places of interest. Small and micro UAVs are also able to fly under cloud cover, while maintaining visual line of sight (**VLOS**), because of the systems' ability to be closer to the ground than a manned aircraft or a larger UAV. This makes the systems more valuable in a post disaster situation. Small UAVs are defined by the Federal Aviation Administration as a system under fifty-five pounds that can only reach restrictive altitudes. A micro UAV is anything less than one meter in dimension and less than one kilogram in weight. Small UAVs (**sUAV**) are most frequently used in post-disaster situations since they are sturdier and can carry a larger payload than micro UAVs.[5]

Also, for the purpose of resource requests, it is important to understand the number of personnel needed to man one UAV. It is recommended that when operating a UAV it is done in a three-man team consisting of a pilot in command (**PIC**), mission specialist, and flight director. The PIC is in charge of preparing the flight, maintaining safe operations of the system, and piloting the aircraft. The mission specialist, also known as the payload specialist, is in charge of collecting data post-flight and can be a representative of the stakeholders involved in the mission. The flight director, also known as the safety officer, is in charge of ensuring safety of the team and making sure standards are met in order to reduce the risk of the mission.[6] For efficiency sake, it is possible to combine the flight director and the mission specialist position. However, best practice recommends keeping the two positions separated.

Current Uses

Urban Search and Rescue

Currently, one of the most frequent uses for UAVs in the government is for urban search and rescue missions (**USAR**). In February 2016, a UAV exercise was conducted in Virginia Key, Florida. This exercise was a full-scale urban search and rescue mission. In the scenario, a hurricane hit South Florida and only a partial evacuation of the residents and tourists took place before the storm hit. The exercise tested

[3] (Murphy, 2014, p. 116)
[4] (Murphy, 2014, p. 112)
[5] (Murphy, 2014, p. 113)
[6] (Murphy, 2014, p. 123)

mass search and rescue operations, planning, operational communications, environmental response health and safety, UAV capabilities, and public and private sector resources after a disaster. There were 118 players including UAV pilots from Florida State University, Florida Urban Search and Rescue Task Force 2, the Miami Beach Light Technical Response Team, City of Miami Fire Rescue, and the National Geospatial Intelligence Agency. One goal was to coordinate extrication strategy with medical personnel, identifying potential victim locations and hazards, ensuring victims are medically stable, and mapping the search area. This exercise was viewed as a success as the UAVs were able to aid first responders in finding many of the missing "people" (dummies) in the exercise.[7]

Another example of UAVs being used in USAR missions was in May of 2016 at the Florida Statewide Hurricane Exercise (HURREX). It was a functional exercise that was testing continuity of operations **(COOP)** for the State Emergency Operations Center **(SEOC)** as well as the UAV integration plan written in the Air Operations Branch Guide. The pilots included the Florida State University team, as well as many county pilot teams. The Florida State University **(FSU)** team was able to provide first responders with orthophotos of the area, real time, up to date maps, as well as over watch to leaders of the USAR teams and a live video feed into the Emergency Operations Center that was now at the COOP location. The team of pilots were able to sustain a continuous video feed for three hours, giving leaders the information they need to make informed decisions.[8]

In the 2015 Wimberley Flood, members of the Austin Fire Department's Robotic Emergency Deployment team deployed unmanned aerial vehicles to the area in order to look for survivors. A white paper was later developed on the subject that outlined many challenges that need to be addressed for the future use of UAVs, which are also outlined in this paper.[9]

On May 16th, 2016, the Florida State University UAV Pilot Team deployed to a real-world event in Levy County in response to a missing person case. During this deployment the UAV team worked alongside a canine unit that had been previously trained to work with UAVs. The mission was viewed as a success, even though the UAVs were unable to find the individual, as the teams were able to cover over a square mile around the last location where the canine unit had tracked the individual. This shows the enhanced capabilities UAVs offer first responder groups by expanding search areas in a short amount of time and giving different type of teams points of interest through the aerial imagery. The individual was later found in a home after hitch hiking to the next county over.

Since USAR operations are one of the most frequent capabilities of UAVs there has been a good amount of research on best practices. One such study was produced at the University of Oxford in the Computing Laboratory by Sonia Waharte and Niki Trigoni. In this study Waharte and Trigoni analyzed the use of UAVs within USAR missions and outlined some of the challenges they experienced while working with the UAVs as well as some search strategies. The conclusion of the study left that UAVs are a valuable addition to the mission but that certain parameters, such as quality of sensory

[7] (Florida Task Force 2, 2016)
[8] (Benk, 2016)
[9] (Kessler & Robinson, 2015)

operations, energy constraints, environmental hazards, and data sharing, need to be accounted for during the mission in order to be most effective.[10]

Within FEMA there has been movement by USAR teams to implement and create a Standard Operating Procedure (**SOP**) for the use of UAVs in disaster situations. Between the Department of Homeland Security, Department of Defense, Department of State, US Coast Guard, and many other federal agencies, an Unmanned Aircraft System Search and Rescue Addendum is being drafted to the National Search and Rescue Supplement to the International Aeronautical and Maritime Search and Rescue Manual. This guide is currently still being drafted and is not yet available to the public.

Mapping and Reconnaissance

The next most popular mission for UAVs, in the government, are using the aerial photos and data collected to create orthophotos. An orthophoto is a photo map that can be accurately laid over an existing map to get the most up to date view. Orthophotos can be used to identify potential hazards for first responders or identifying areas of interest to be analyzed. These maps can also be used for planning purposes, such as identifying flood lines and potentially at-risk areas.[11]

Most of the missions that are done using a rotary wing UAV utilize applications to map out the most efficient path. These apps allow the team of UAV pilots to map out the mission prior to flight to know the exact dimensions of the area being taken pictures of and know the exact amount of time the bird will be in flight. This is a safety precaution that can minimize many of the risks to the team as well as any civilians that may be in the area.[12]

Humanitarian Uses

There has also been an increased interest in using UAVs in Humanitarian efforts. Humanitarian organizations have been known to use UAVs for a number of mission capabilities including data collection and observation consisting of real time information and situation monitoring, such as rapid assessment of damage, monitoring distribution of goods, identifying and analyzing temporary settlements or tracking displacement or movement of people, and public information and advocacy. These same organizations also use UAVs for logistical and package-delivery, most commonly of medical resources.[13]

An example of humanitarian UAV use was in Dar es Salaam in Tanzania. In Tanzania, the objective was to obtain up to date exposure maps of the affected communities from a flood from a previous year as well as create a hydrological model using elevation data. The non-profit organization that conducted these missions were a non-profit organization based out of Switzerland called Drone Adventures. The deployed team used an eBee, "fully automated mapping drone manufactured by Sensefly,"a fixed wing micro UAV, and the Postflight Terra 3D software to stitch the aerial photos and data together.[14]

Other examples of humanitarian led efforts include after Hurricane Sandy in 2012 in Haiti when the International Organization for Migration (**IOM**) and the OpenStreetMap

[10] (Waharte & Trigoni, n.d.)
[11] (U.S. Geological Survey, 2013)
[12] (3DR, n.d.)
[13] (United Nations Office for the Coordination of Humanitarian Affairs, 2014, pp. 5-8)
[14] (Soesilo, 2015)

Community of Haiti (**COSMHA**) deployed using a Swinglet Fixed Wing Mapping Micro-drone to conduct rapid damage assessments.[15]

Current Research

With the increase of UAV driven missions, there has been a dramatic rise in the amount of research done as well. There are many conferences that are held to showcase that research, one example being the International Conference of Unmanned Aircraft Systems (**ICUAS**), which was held in Washington, DC in May, 2016. This conference brings together much of the UAV community that is not just made up of pilots, but also engineers and mathematicians looking to better the missions and work towards completely autonomous flights and effective guarded motion.

One of the most popular ideas at the local level for using UAVs is debris estimates. The UAV would, ideally, be able to fly over an area, collect aerial photos, which will then be developed into an orthophoto and use that product to create a debris estimate. This procedure being developed is meant to be fast. Not only does it help the county with being quicker to get more grant money, but it also tells the county which roads need to be cleared first for first responders and which areas are in the most need of help. One study that is looking more in depth into this is currently being done at FEMA by a Department of Homeland Security (**DHS**) intern and will, ideally, include an algorithm and toolbox for creating these estimates in ArcGIS that is easy to do and efficient.

In a study done by the Institute for Technical Informatics at Graz University of Technology, scientists examined ways to create autonomous flight for several micro UAVs at one time to give situational awareness to first responders on the ground while detecting potential places of interest. The UAVs were able to fly simultaneously by maintaining a wireless communication channel between them giving the UAVs spatial awareness. However, this study mainly examined the challenges of the experiment rather than whether or not the experiment would be considered a success.[16] Simultaneously flying UAVs have been a topic of debate not only in the scientific world, but also in regulation and simulation. This research was done using micro UAVs and, recent regulations make it an offense to use small UAVs, or anything larger, together in autonomous flight using one controller.[17]

Taro Suzuki, an Assistant Professor at Waseda Institute for Advance Study, conducted a study that focused on generation of real-time hazard maps. This study utilized highly-accurate localization methods based in GNSS, 3D measurements, and integration of geospatial information into the sensor networks. Suzuki used two methods of creating real-time maps, one being through the creation of orthomosaics, as mentioned above. The other method was by taking the UAV data and aerial photos during flight and projecting the data onto a known map of the area.[18] This study was mostly focused on providing situational awareness for a disaster.[19]

Noted Organizations

[15] (Lessard-Fontaine, Alschner, & Soesilo, 2012)
[16] (Quaritsch, et al., 2010, pp. 57, 61)
[17] (Federal Aviation Administration, 2016)
[18] (Suzuki, et al., 2008, pp. 444-445)
[19] (Suzuki, et al., 2008, p. 446)

There are a few organizations that are doing research and operations of UAVs very well, most of them being public universities. Florida State University offers a certificate program for undergraduate and graduate students in the applications of unmanned aircraft systems. These classes vary from policy to UAV operations to geographic information systems. Along with teaching classes, some of the faculty associated with the Center for Disaster Risk Policy (**CDRP**) deploy to exercises and real-world events to fly unmanned operations, such as the missing person case in Levy County, mentioned above, and flights in Belize to create a map of the city.[20] Florida State University has been named the State of Florida's Unmanned Aircraft Coordinators for post-disaster situations and have participated in many of the state-wide hurricane exercises in an air boss capacity. Texas A&M is another university that has made huge leaps in disaster robotics. Robin Murphy, one of the faculty at the Center for Robot Assisted Search and Rescue (**CRASAR**) within the Engineering Department at Texas A&M University, wrote a book called *Disaster Robotics* that covers an extensive history of unmanned aerial vehicles and their missions and capabilities. Robin Murphy has been doing research on the applicability of UAVs in post disaster situations long before joining Texas A&M University. Murphy and her team from the University of South Florida were deployed to multiple disasters to give aid including Hurricane Katrina. Texas A&M's main goal is to "improve disaster preparedness, prevention, response, and recovery through the development of robots and related technology." The CRASAR team has been responsible for 15 of the 35 documents cases of deployments post-disaster of disaster robotics.[21]

UAViators is a humanitarian network specifically made for UAV pilots, policy workers, and hobbyists to promote and coordinate effective use of data collection, cargo delivery, and communication services. The organization originally started very small but has now grown to be one of the leading voices on the use of UAVs for response efforts. The UAViators' website includes resources on best practices and FAA regulations. Within UAViators are a number of teams varying from humanitarian, flight, imagery, research, camera, policy, cargo, and legal teams just to name a few. This organization promotes safe flying while coordinating organizations within the UAV community to help in disaster situations.[22] These are just a few of the organizations that FEMA could look to for guidance in moving forward. Most of the universities that have programs are mainly focused in the engineering, rather than operational side of their use. This makes Florida State University and the University of Hawaii stand out to the UAV community as they are focused on the operator side.

Concerns that need to be addressed

1. Mission capabilities need to be identified

In order for FEMA to effectively use UAVs, FEMA must first recognize what they wish to use the systems for. From there FEMA can create a contact list, an air operations guide, a program for dealing with spontaneous volunteers/UAV pilots, training programs,

[20] (Florida State University Emergency Management and Homeland Security Program, 2016)

[21] (Center for Robot-Assisted Search and Rescue, 2016)

[22] (UAViators, 2016)

identify key legal obligations, and, eventually, apply for a blanket Certificate of Authorization (**COA**). Some mission capabilities that could potentially benefit **FEMA**, but are not limited to: resource air drop, over watch (live video feed of teams to team leaders on the ground), hazard identification, hazard surveillance, debris estimations, critical infrastructure assessments, hazardous materials identification, surveillance of erosion, creation of aerial maps, situational awareness, and live video feed. The capabilities of each UAV are specific to the type of payload being used. For example, LIDAR can be used for pollution monitoring as well as a chemistry or biological sensor. LADAR can be used for obstacle avoidance as well as terrain mapping, or 3D imaging.[23] Many of the mission capabilities and resources available to FEMA, and other federal agencies, is listed within the National Guard Joint Force Headquarters-State J2 Incident Awareness and Assessment (**IAA**) Handbook.

2. Contact List

Currently, FEMA headquarters, or any Regional Office, do not own a UAV, excluding the USAR teams. For this reason it is important that if FEMA wants to utilize this technology that they create a contact list of individuals that own a UAV and have been trained to use it. Some Department of Homeland Security (**DHS**) agencies with UAVs include Customs and Border Protection (**CBP**) and the US Coast Guard (**USCG**). CBP uses UAVs for mostly border surveillance and law enforcement missions, but the agency's unmanned systems are equipped with video, radar, and other sensor packages that can be utilized for emergency management purposes.[24] **USCG** has a small UAV called a ScanEagle used for surveillance purposes.[25]

As for non-DHS agencies the list is much longer. The Department of Agriculture, specifically the Forest Service, uses UAVs for forest health protection, suppression of wildfires, research, recreational impacts, and law enforcement activities. The Forest Service also has a UAV Advisory Group that reviews policies, makings recommendations, completes risk assessments, and develops strategic plans.[26]

The Department of Defense (**DoD**), including the Air Force Rescue Coordination Center (**AFRCC**), supports federal or state authorities when aviation is needed. However, according to Memorandum 15-002, the DoD is not able to use UAVs within the United States except training, exercise, and testing purposes.[27]

The Bureau of Land Management, within the Department of Interior (**DOI**), own two different types of UAVs, the RQ-11A Raven and the RQ-16 T-Hawk. These UAVs are used for many different missions including wildfire support in Arizona, Florida, and Colorado, taking population inventory, habitat surveys, thermal surveys of lakes and streams, and monitoring impacts of flooding, as seen in the Missouri River Flooding.[28] The National Park Service, also within the Department of Interior, has UAVs that they deploy as well.[29]

The Environmental Protection Agency (**EPA**) have UAVs that are used for intelligence, surveillance, target acquisition, and reconnaissance (**ISR**) as well as extending communications range.[30] The National Guard

[23] (Hintz, 2005)
[24] (Department of Homeland Security, 2013)
[25] (United States Coast Guard, 2016)
[26] (U.S. Forest Service, n.d.)
[27] (U.S. Department of Defense, n.d.)
[28] (Brady, 2013)
[29] (National Park Service, n.d.)
[30] (Rees, 2016)

offers UAV services for surveillance during floods and after tornadoes as well as law enforcement activities such as manhunts and drug raids.[31] The Civil Air Patrol also has prior dealings with FEMA and are developing a UAV program. The Department of Justice (**DOJ**) has UAVs that are used for kidnapping investigations, search and rescue, drug interdictions, and fugitive investigations.[32] Other agencies that could be used by FEMA for acquiring a UAV for post-disaster situations include the National Aeronautics and Space Administration (**NASA**) and the National Science Foundation.

FEMA Regional Office 4 out of Atlanta has compiled a list of their own for potential contacts. Including DHS/CBP that own a Predator B and Guardian, USCG that operate a Guardian, ScanEagle and Fire Scout. Also according to Region 4, NOAA is currently exploring the use of Global Hawk, Predator B, Ikhana, and Scan Eagle primarily for high-impact weather, polar, and marine monitoring. USACE would be another contact with a NOVA, eBee, DJI Phantom, and Trimble X5. Department of Energy has recently acquired a Mongoose. NASA operates an Ikhana and Global Hawk. USDA/ARS has a Bat 3/4 as well as FS who is looking at the potential use for wildfires and natural resource management.

3. Air Operations Guide

The current Air Operations Branch Guide is in the middle of being updated. The guide has very minimal information on UAVs as of right now and any operational standards for flying. The current version mentions COAs and the CBP, NASA, and NOAA as contacts for the use of UAS. The section needs to go more into the different types, requirements, and mission capabilities.

The updated version of this guide will include procedures on pre-flight, in-flight, and post-flight checklists, processes for aggregating and using data, aviation frequencies, altitude restrictions, and procedures for manned and unmanned aviation coordination. Aviation can change drastically in a matter of years and therefore should be updated regularly.

For the purposes of specifically using UAVs, FEMA should create safety guidelines and standards that outline checklists that must be followed before each flight, a standard operating picture for data collection and flight control, and a system of validation of both data and the right to be considered pilot in command (PIC).

The reason why it is important to create FEMA's own procedures for collecting and analyzing data is so that way that data can be kept on FEMA's servers to be used throughout the process. This is helpful so that way one database can house all of the data rather than having multiple places for the data which is inefficient.

4. Spontaneous Volunteers/UAV Pilots

Since the 2015 Lake Fire in California, where civilian UAV pilots spontaneously flew over the fire and impeded firefighting operations, spontaneous UAV pilots has become a major problem for first responders and emergency managers. That fire ended up burning an additional 3.5 square miles because one four-foot UAV inhibited manned fire suppression aircraft to access the area.[33] This is not the only

[31] (NPR, 2015)

[32] (Department of Justice, n.d.)

[33] (Barbash, 2015)

example of spontaneous volunteer UAVs, but it is the most well-known.
Please see *Action Items* section for proposed solution.

5. Blanket Certificate of Authorization
Another issue that needs to be resolved is the issue of the Certificate of Authorization (**COA**). Currently, a Certificate of Authorization is issued for a specific capability in a specific area. There is no nation-wide COA at the moment for the federal government to use.[34] However, many federal agencies, as seen from the list above, have been able to somewhat get around this rule. This will not be an issue for FEMA unless FEMA employees are the ones implementing and piloting the UAV. If another agency is flying on behalf of FEMA or as a volunteer then they must have proper documentation with the Federal Aviation Administration, but FEMA is not responsible for having a COA in this instance. However, it should be a top priority by FEMA to make sure that any aviation pilot participating in a post-disaster event has the proper certifications and registration as FEMA may be liable in a risk sense. FEMA may be liable based on mission assignment or Memorandums of Understanding (**MOU**), which transfers inherent risks within agencies.
To operate outside of a prescribed COA, an agency will have to apply for an emergency COA which can be granted after an emergency for life saving operations. On September 10, 2014, the FAA issued its first emergency COA for an urban search and rescue mission out of Texas looking for a missing woman near Dallas. Emergency COAs can be issued if three standards can be met: 1) when there is a distress or emergency with a potential loss of life; 2) manned flight cannot be conducted efficiently; 3) the UAS operator has a current approved COA for another location or purpose.[35]

6. Training Program
In order for FEMA to effectively use UAVs, training programs will need to be developed in addition to the requirement set by the FAA in part 107 to have a Remote Pilot Airman Certificate, effective August 2016.[36] When training for UAVs it is important to understand that there are many different areas to train for. There needs to be a basic training on regulations, then capabilities, then types of operations, and finally piloting. There also needs to be separate trainings on utilization of data that is acquired in flight. Along with training, there need to be regulations on pilot certifications, such as minimum number of flight hours needed to operate a UAV during a disaster, as well as setting up a training facility to promote safe flying.
There has been a training made by the University of Hawaii that promotes situational awareness on the benefits of UAVs including any documents that need to be filed to the FAA in order to fly. A second course from the University of Hawaii is currently in the works but is on hold until results of a survey for the first training are back. The University of Hawaii focuses on the state and local level and will travel to site requesting the training.

7. Legal Obligations
Finally, there are also legal issues that need to be addressed: What is FEMA legally allowed to do

[34] (Federal Aviation Administration, 2016)
[35] (Federal Aviation Adminsitration, 2014)
[36] (Federal Aviation Administration, 2016)

for aviation? Are there issues if FEMA were to call for the aid of another agency using UAVs? Can FEMA even be associated with other agencies that would be using UAVs? What about volunteers? Most legal issues will have to do with safety, liability, privacy, and data protection.[37]

Also, as mentioned before MOUs can cause FEMA to be liable for if an accident happens when another agency is flying for FEMA. This can cause a problem later on and should be thoroughly looked at by a legal team.

Action Items

In order to utilize UAVs to their full potential, FEMA will need to create a Standard Operating Procedure and Guide that outlines many safety standards and regulations made by FEMA outside of the FAA as well as create a contact list and work in tandem with the training already available to promote safe flying from the state and local level agencies.

One action item that is recommended is the creation of checklists. These checklists should be detailed instructions on how to do anything pertaining to the system. There should be separate checklists for pre-flight, arming, taking off, in-flight, and post-flight. It is crucial to include all of the necessary steps as it is easy to become forgetful when being in the sun for many hours a day. A checklist should also be created for the data collected and what information needs to be in each report for the flight.[38] This should be a requirement of any team operating a UAV. Especially in disaster situations, it is important to be efficient and quick. These checklists should be somewhat standardized among the agency in order to promote interoperability.

A second action item is to create a contact list with a list of resources and what each agency is trained in doing. In **Appendix B**, an example of what that chart would look like is created. But in order for this to be most effective, FEMA would need to hold bi-annual meetings with stakeholders. UAV regulation is a constantly adapting body that can, at times, be hard to keep up with, which is why more meetings are better than fewer.

The third recommended action item is to develop a program similar to Volunteer Organizations Active in Disaster (**VOAD**) to use volunteer pilots so they can supply aerial photos and data to FEMA in a post-disaster scenario if they coordinate with the JFO. Similarly, prior to a disaster volunteer UAV pilots could produce aerial maps and supply the data to FEMA to be aggregated and collected. This can be used to create a nation-wide footprint, monitor flood erosion, or monitor critical infrastructure. The only stipulation is that regulations would need to be put in place. A process of UAV pilots flying and handing over data would need to be identified as well as a way to validate the data that is given and a need or way of implementing that data. Lastly, a SOP and training program needs to be developed to standardize the use of UAVs within FEMA. Having a standard for flight and data will make it easier for FEMA to encourage local and state government to use UAVs and be able to ensure that the organizations are doing it safely and gathering the right information.

[37] (United Nations Office for the Coordination of Humanitarian Affairs, 2014, p. 9)

[38] (Murphy, 2014, p. 125)

Appendix A

Created by the Federal Aviation Administration

June 21, 2016

SUMMARY OF SMALL UNMANNED AIRCRAFT RULE (PART 107)

Operational Limitations	• Unmanned aircraft must weigh less than 55 lbs. (25 kg). • Visual line-of-sight (VLOS) only; the unmanned aircraft must remain within VLOS of the remote pilot in command and the person manipulating the flight controls of the small UAS. Alternatively, the unmanned aircraft must remain within VLOS of the visual observer. • At all times the small unmanned aircraft must remain close enough to the remote pilot in command and the person manipulating the flight controls of the small UAS for those people to be capable of seeing the aircraft with vision unaided by any device other than corrective lenses. • Small unmanned aircraft may not operate over any persons not directly participating in the operation, not under a covered structure, and not inside a covered stationary vehicle. • Daylight-only operations, or civil twilight (30 minutes before official sunrise to 30 minutes after official sunset, local time) with appropriate anti-collision lighting. • Must yield right of way to other aircraft. • May use visual observer (VO) but not required. • First-person view camera cannot satisfy "see-and-avoid" requirement but can be used as long as requirement is satisfied in other ways. • Maximum groundspeed of 100 mph (87 knots). • Maximum altitude of 400 feet above ground level (AGL) or, if higher than 400 feet AGL, remain within 400 feet of a structure. • Minimum weather visibility of 3 miles from control station. • Operations in Class B, C, D and E airspace are allowed with the required ATC permission. • Operations in Class G airspace are allowed without ATC permission. • No person may act as a remote pilot in command or VO for more than one unmanned aircraft operation at one time. • No operations from a moving aircraft. • No operations from a moving vehicle unless the operation is over a sparsely populated area. • No careless or reckless operations. • No carriage of hazardous materials.

	• Requires preflight inspection by the remote pilot in command.
	• A person may not operate a small unmanned aircraft if he or she knows or has reason to know of any physical or mental condition that would interfere with the safe operation of a small UAS.
	• Foreign-registered small unmanned aircraft are allowed to operate under part 107 if they satisfy the requirements of part 375.
	• External load operations are allowed if the object being carried by the unmanned aircraft is securely attached and does not adversely affect the flight characteristics or controllability of the aircraft.
	• Transportation of property for compensation or hire allowed provided that-
	  ○ The aircraft, including its attached systems, payload and cargo weigh less than 55 pounds total;
	  ○ The flight is conducted within visual line of sight and not from a moving vehicle or aircraft; and
	  ○ The flight occurs wholly within the bounds of a State and does not involve transport between (1) Hawaii and another place in Hawaii through airspace outside Hawaii; (2) the District of Columbia and another place in the District of Columbia; or (3) a territory or possession of the United States and another place in the same territory or possession.
	• Most of the restrictions discussed above are waivable if the applicant demonstrates that his or her operation can safely be conducted under the terms of a certificate of waiver.

Remote Pilot in Command Certification and Responsibilities	• Establishes a remote pilot in command position.
	• A person operating a small UAS must either hold a remote pilot airman certificate with a small UAS rating or be under the direct supervision of a person who does hold a remote pilot certificate (remote pilot in command).
	• To qualify for a remote pilot certificate, a person must:
	  ○ Demonstrate aeronautical knowledge by either:
	  □ Passing an initial aeronautical knowledge test at an FAA-approved knowledge testing center; or
	  □ Hold a part 61 pilot certificate other than student pilot, complete a flight review within the previous 24 months, and complete a small UAS online training course provided by the FAA.
	  ○ Be vetted by the Transportation Security Administration.
	  ○ Be at least 16 years old.
	• Part 61 pilot certificate holders may obtain a temporary remote pilot certificate immediately upon submission of their application for a permanent certificate. Other applicants will obtain a temporary remote pilot certificate upon successful completion of TSA security vetting. The FAA anticipates that it will be able to issue a temporary remote pilot certificate within 10 business days after receiving a completed remote pilot certificate application.
	• Until international standards are developed, foreign-

	certificated UAS pilots will be required to obtain an FAA-issued remote pilot certificate with a small UAS rating. A remote pilot in command must: • Make available to the FAA, upon request, the small UAS for inspection or testing, and any associated documents/records required to be kept under the rule. • Report to the FAA within 10 days of any operation that results in at least serious injury, loss of consciousness, or property damage of at least $500. • Conduct a preflight inspection, to include specific aircraft and control station systems checks, to ensure the small UAS is in a condition for safe operation. • Ensure that the small unmanned aircraft complies with the existing registration requirements specified in § 91.203(a)(2). A remote pilot in command may deviate from the requirements of this rule in response to an in-flight emergency.
Aircraft Requirements	• FAA airworthiness certification is not required. However, the remote pilot in command must conduct a preflight check of the small UAS to ensure that it is in a condition for safe operation.
Model Aircraft	• Part 107 does not apply to model aircraft that satisfy all of the criteria specified in section 336 of Public Law 112-95. • The rule codifies the FAA's enforcement authority in part 101 by prohibiting model aircraft operators from endangering the safety of the NAS.

Appendix B

Agency Name	Point of Contact Name (Last, First)	Point of Contact Phone Number	Point of Contact Email	Address of Base	Resources Available (List all available including payloads, batteries, etc.)	Missions Trained in:	Able to Send Personnel with Resources:

Resources

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Acronyms and Definitions

AFRCC – Air Force Rescue Coordination Center – is an organization within the **Department of Defense**. Serves as the single agency responsible for coordinating on-land federal **SAR** activities in the United States, including Puerto Rico and U.S. Virgin Islands.

CBP – Customs and Border Protection – is a federal law enforcement agency of the United States **Department of Homeland Security**. It is charged with regulating and facilitating international trade, collecting import duties, and enforcing U.S. regulations, including trade, customs, and immigration.

CDRP – Center for Disaster Risk Policy – center within Florida State University. *See **FSU**.*

COA – Certificate of Authorization – is an authorization issued by the **FAA** to a public operator for a specific **UAV** activity.

COOP – Continuity of Operations – as defined in the National Continuity Policy Implementation Plan and the National Security Presidential Directive-51/Homeland Security Presidential Directive-20 (NSPD-5/HSPD-20), is an effort within individual executive departments and agencies to ensure that Primary Mission Essential Functions (PMEFs) continue to be performed during a wide range of emergencies, including localized acts of nature, accidents and technological or attack-related emergencies.

COSMHA – OpenStreetMap Community of Haiti – creates and provides maps for relief organizations who need the resources for responding to disasters and crises.

CRASAR – Center for Robot Assisted Search and Rescue – is an element of Texas A&M where research has been done on the use of robots, and related technology, after a disaster happens.

DHS – Department of Homeland Security – is a federal agency designed to protect the United States against threats. Its wide-ranging duties include aviation security, border control, emergency response and cybersecurity.

DOD – Department of Defense – is a department of the federal executive branch entrusted with formulating military policies and maintaining American military forces.

DOI – Department of Interior – is the federal executive department of the U.S. government responsible for the management and conservation of most federal land and natural resources.

DOJ – Department of Justice – is a department of the federal executive branch, headed by the attorney general, which administers the Federal Bureau of Investigation (FBI), prosecutes violations of federal law, and is responsible for enforcing all civil rights legislation.

EOC – Emergency Operations Center – is a central command and control facility responsible for carrying out the principles of emergency preparedness and emergency management, or disaster management functions at a strategic level during an emergency, and ensuring the continuity of operation of a company, political subdivision or other organization.

EPA – Environmental Protection Agency – is an agency of the United States federal government whose mission is to protect human and environmental health

FAA – Federal Aviation Administration – is the national aviation authority of the United States. As an agency of the United States Department of Transportation, it has authority to regulate and oversee all aspects of American civil aviation.

FEMA – Federal Emergency Management Agency – an independent agency of the United States government that provides a single point of accountability for all federal emergency preparedness and mitigation and response activities.

FSU – Florida State University – is a public university in Florida containing two certificate programs: Certificate in Emergency Management and Homeland Security and Certificate in the Application in Unmanned Aircraft Systems. FSU has been appointed as the Unmanned Aircraft Coordinator for the Florida Division of Emergency Management.

IAA – Incident Awareness and Assessment – is similar to **ISR**. However, ISR is conducted outside of the United States in foreign territory and IAA is conducted within the United States for DSCA operations.

ICUAS – International Conference of Unmanned Aircraft Systems – is an international conference where researchers can show off their finished products. Includes military, governmental, and non-governmental agencies.

IOM – International Organization for Migration – is an inter-governmental organization that works in mitigation efforts and works alongside government, intergovernmental, and non-governmental partners.

ISR – Intelligence, Surveillance, and Reconnaissance – is the acquisition and processing of military intelligence.

JFO – Joint Field Office – a temporary multiagency coordination center established at the incident site to provide a central location for coordination of federal, state, local, tribal, nongovernmental, and private-sector organizations with primary responsibility for incident oversight, direction, or assistance to effectively coordinate protection, prevention, preparedness, response, and recovery actions.

MOU – Memorandum of Understanding – is a formal agreement between two or more parties agreeing to establish a partnership.

NASA – National Aeronautics and Space Administration – is in charge of U.S. science and technology that has to do with airplanes and space.

PIC – Pilot in Command - in charge of preparing the flight, maintaining safe operations of the system, and flying.

SEOC – State Emergency Operations Center – *see **EOC***.

SOP – Standard Operating Procedure – established or prescribed methods to be followed routinely for the performance of designated operations or in designated situations.

sUAS – Small Unmanned Aircraft System – *see **UAV***.

UAS – Unmanned Aircraft System – *see **UAV***.

UAV – Unmanned Aerial Vehicle – within the United States, UAVs are classified as aircraft and regulated accordingly. The FAA Modernization and Reform Act of 2012 defines an unmanned aerial

vehicle as an unmanned aircraft and associated elements (including links and the components that control the unmanned aircraft) that are required for the pilot in command to operate safely and efficiently in the national airspace system. The UA is defined as a device used or intended to be used for flight in the air that has no pilot. This includes all classes of airplanes, helicopters, and translational lift aircraft that have no onboard pilot. Unmanned aircraft are understood to include only those aircrafts controllable in three axes and therefore exclude traditional balloons.

USAR – Urban Search and Rescue – provides for the coordination, development, and maintenance of the Federal effort with resources to locate, extricate, and provide immediate medical treatment to victims trapped in collapsed structures; and to conduct other lifesaving operations.

USCG – United States Coast Guard – is a branch of the US armed forces, under the Department of Transportation, responsible for the enforcement of maritime law and for the protection of life and property at sea.

VLOS – Visual Line of Sight – this must be maintained throughout the duration of the UAV mission per FAA part 107.

VOAD – Voluntary Organizations Active in Disaster – is a nonprofit, nonpartisan membership organization that serves as the forum where organizations share knowledge and resources throughout the disaster cycle to help communities prepare for and recover from disasters.

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Keywords: UAV, unmanned, unmanned aerial vehicle, UAS, FEMA, DHS, Homeland Security
WHITE PAPER ON the USE OF UAVS WITHIN FEMA

Unmanned Aerial Systems
Region 1 Working Group

Chad CouncilFEMA Region IRegional Geospatial Coordinator April 3, 2018

FEMA

Agenda

- IntroductionsDiscuss purpose of the groupDiscuss approach of the groupDefine initial set of topics Mass DOT: Quincy / MBTA Response during nor'easter Open Discussion

Purpose

Kick off meeting to foster cross collaboration between the states and provide visibility to states and FEMA on UAS resources available/developing in the area.

Introductions

- FEMA Region 1Air OperationsGIS/Remote SensingOperations IntegrationIncident SupportSituation Awareness US&RCivil Air PatrolDHS Infrastructure ProtectionUSACE
- CTDEMHS GISMAMEMA GISMass DOTMWRAMEMaine GISMEMA GIS
- NHNH HSEMNH DOTRIRIEMA GISVTVEM GIS/Higher EducationHarvard Humanitarian InitiativeUniversity of Vermont

Purpose of this Group

- Combine Air Operations with Remote Sensing/GIS leads Develop, share, learn best practices such that UAS are easily integrated into Emergency Management in Region 1Establish venue for sharing progress from other FEMA regions and federal partnersPossible Final outcomes: Region 1 UAS Emergency Management GuideContinued collaboration between the states and Region I as new developments occur on UAS resources and uses

Group Approach

- Meet monthly to discuss specific topics each meeting. Cross share information on that topic, coming up with an initial set of shared guidance for that topic

Topics

- Legal / Privacy challengesUAS Capability reviewData storage Emergency Management Uses / Case StudiesEmployment approachesAir Operations IntegrationCross sharing of information/best practices/challenges with other RegionsConnecting Region I initiatives with FEMA Air Ops course/curriculumIntegrating UAS guidance from other Federal agencies

MassDOT Case Study

- MBTA Support in Quincy, MA

Open Discussion

- Thoughts?

Region 1 Unmanned Aerial Systems Working Group

Agenda

April 3, 2018 | Webinar

14:00 – 15:300

Adobe Connect: https://fema.connectsolutions.com/r1gis

Call in 800-320-4330 PIN (b)(6)

Purpose: Kick off meeting to foster cross collaboration between the states and provide visibility to states and FEMA on UAS resources available/developing in the area.

Tuesday, April 3, 2018

Agenda

- Introductions

- Describe purpose of group:
  - Combine Air Operations with Remote Sensing/GIS leads
  - Develop, share, learn best practices such that UAS are easily integrated into Emergency Management in Region 1
  - Establish venue for sharing progress from other FEMA regions and federal partners
  - Possible Final outcomes:
    - Region 1 UAS Emergency Management Guide
    - Continued collaboration between the states and Region I as new developments occur on UAS resources and uses

- Describe approach of group: Meet monthly to discuss specific topics each meeting. Cross share information on that topic, coming up with an initial set of shared guidance for that topic

- Layout initial set of topics (not in any particular order):
  - Legal
  - UAS Capability review
  - Data storage
  - Emergency Management Uses
  - Employment approaches
  - Air Operations Integration
  - Cross sharing of information/best practices/challenges with other Regions
  - Connecting Region I initiatives with FEMA Air Ops course/curriculum
  - Integrating UAS guidance from other Federal agencies: FAA, DHS, USFS, DoD, USGS, etc.

- Discuss topics to add / remove?

- MassDOT: Quincy / MBTA Response during nor'easter

- Open Discussion

FEMA

Region 1 Unmanned Aerial Systems Working Group

Notes

April 3, 2018 | Webinar
14:00 – 15:300
Adobe Connect: https://fema.connectsolutions.com/r1gis
Call in 800-320-4330 PIN (b)(6)

Purpose: Kick off meeting to foster cross collaboration between the states and provide visibility to states and FEMA on UAS resources available/developing in the area.

Tuesday, April 3, 2018

- Participant Introductions: Significant experience across several agencies and states.
- FEMA Memo: Authorizing mission assignments of federal agencies with UAS capability

- Discussed Group Outcomes:
  - Region 1 UAS in EM Guide
    - State resource and contact indexes, to be developed and maintained by states
    - Federal Resources Available
    - Initiation of cross-state EMAC requests of UAS resources
      - Note NIMS Resource typing here:
        - https://www.fema.gov/media-library/assets/documents/157327
  - Revision to Annex for Aviation Response Plan
  - Repository for documents developed during efforts
    - FEMA can support with HSIN Group
      - https://hsin.dhs.gov/dhs/FEMA/Regions/RIGIS/
      - Requires HSIN credentials which may be burdensome
    - University of Vermont can support with unlimited drobox usage
      - Challenge for FEMA to access, will investigate

- Collaboration: Close geographic nature of New England means we already work closely with each other. Makes sense to continue that with UAS
  - Several mentions of interacting with New York (borders 3 states). Will invite Region 2 to participate if they'd like.
  - MassDOT application for UAS Integration Pilot Program. If they, or anyone else in Region 1 is awarded, , would want to collaborate
  - Begin collaborations as soon as possible with exercises. Known exercise in November (MA Vigilant Guard). Any sooner? Will investigate with R1 Exercise branch.
  - Harvard Humanitarian Initiative publishing academic paper of lessons learned during last year's hurricane season. Will share non-academic version as well.

- Group Format: Monthly webinar, focused on specific topic.
  - Audience may vary by topic. Specify target audience in invitation
  - Date to be set through doodle poll.
  - Research recording options: FEMA Adobe Connect , UVM YouTube

- Discussed Topic Areas of concern:
    - Communication during operations:
        - Interoperability
        - Knowledge of aviation terminology
        - Air Operations de-confliction
    - Data security and Privacy: Best practices for storing imagery, prevention of capturing PII
- Additional Topics for discussion sessions:
    - Legal constructs
        - Licensing for operating
        - Privacy for imagery
        - Other State/Federal regulations
    - UAS Capabilities
        - Sensors, payloads, unique characteristics (e.g. waterproof)
    - Data Storage
    - Employment approaches
        - Internal team vs. contracting or mutual aid, etc.
        - mechanisms for alerting groups
    - Imagery collection standards: best practices for mission types

- Case Study: MassDOT support to MBTA during Nor'easter
    - Public bus trapped/inaccessible due to coastal flood waters (4' covering roadway)
    - Team deployed DJI Inspire to determine vehicle location and status
        - Streamed stills and video to OCC
    - Lessons Learned:
        - Power: additional batteries and/or mobile generator power
        - Location was in Class B Airspace for Boston Logan International Airport
            - Emergency waiver with 100 ft. ceiling obtained verbally by phone in about 5 minutes. MassDOT has procedure in place with phone numbers, etc.

Next Meeting Topic: TBD

Next meeting: TBD May, 2018

Region I: Unmanned Aerial Systems Executive Summary

Summary: Region 1 GIS, in the operational planning branch of the response division, has been exploring the use and integration of Unmanned Aerial Systems and UAS derived products since 2013. Much of the effort has been in collaboration with educational partners in New England. These partners include the University of Vermont Spatial Analysis Lab (which is a US DOT funded UAS research facility) and the Harvard Humanitarian Initiative, at Harvard University. Additional partners include MA-TF 1 Urban Search & Rescue, U.S. Air Force Civil Air Patrol Northeast Liaison (CAP USAF NELR) and internal FEMA Region 1 staff to include Situation Awareness Section, Ops Integration, and Air Operations.

Given the current UAS operation activity by state and local partners in Region 1, we fully expect UAS to be involved in a response, with or without FEMA. To that end, we have adopted the stance that we should be prepared to understand and incorporate UAS derived products, coordinate with those partners on activity, and if possible pursue the use of UAS ourselves *when operationally appropriate*.

To support that stance, we have a draft guide to follow for Incident Support or Incident Management activations. The document is intended to guide staff through the decision whether or not to employ UAS for a specific task and to provide resources for leveraging UAS derived products collected by partner organizations.

Next Steps: The draft "Region 1 UAS Guide" will be refined in 2017 to include a tool for end readers to match UAS capabilities with mission needs and further guide them toward teams or agencies capable of providing those capabilities.

Specific Efforts to Date

- 2013: "Ad Hoc Aerial Imagery" concept: Working with MA-TF 1 USS&R and a privately owned DJI Phantom, created a briefing to illustrate the potential for tactical field use. Disseminated to US&R Branch and GIO. Periodic SME input to US&R branch is ongoing.
- October 2015: Supported collaboration between MA-TF 1 US&R and University of Vermont UAS team for multi-day Urban Search & Rescue mobilization exercise. Worked with UVM to define mechanisms for leveraging UAS products.
- December 2015: Presented at quarterly Regional Interagency Steering Committee (RISC) meeting on potential for UAS in disaster response and recovery.
- July 2016: Attended 5 day course on Remote Sensing for Humanitarian Efforts with Harvard Humanitarian Initiative. Course includes significant material on UAS international case studies. Disseminated course content to GIO.
- July 2016: Held workshop meeting with Harvard Humanitarian Initiative, FEMA R1 Ops Integration, Operational Planning, and Air Operations.
- October 2016: Attempted support of collaboration between MA-TF 1 US&R and UVM during mobilization exercise; clearance for flight never granted.
- Peer review of "UAV within FEMA Whitepaper" by Bridget Joyner.
- October 2016: Facilitated peer review of Region 1 UAS Guide by HHI, UVM, FEMA.
- November 2016: In collaboration with Harvard Humanitarian Initiative, University of Vermont, FEMA Remote Sensing Coordinator and Region 1 Air Operations Branch Director, released internal draft "**Region 1 UAS Guide**". The document's intent is to guide Region 1 Air Ops and Remote Sensing efforts for events that will include UAS.

- November 2016: Attended FEMA/University of Hawaii class "UAS in Disaster Management"
    - In coordination with FEMA Remote Sensing Coordinator, began communicating with course developers to identify ways to improve the case studies and incorporate UAS advances into the class.
- December 2016: With support of Operations Integration Branch, coordinated a full day Regional Interagency Steering Committee (RISC) conference on remote sensing and UAS. Attended by approximately 100 federal, state and local partners in New England. Presentations included FAA, USACE, CAP USAF, University of Vermont, Harvard Humanitarian Initiative, and National Grid.
- April, 2017: Participated in 2 day conference at Harvard University on "The Drone Revolution in Spatial Analysis". Met with Harvard Humanitarian Initiative, University of Vermont and CAP USAF NELR.
- April 2017: Supported and coordinated collaboration between CAP USAF and UVM UAS team to incorporate UAS into CAP operations. Included coastal site study for comparison of fixed wing and multi-rotor UAS capability. Exercise also included multi-rotor UAS support of ground team wide area SAR exercise, yielding exceptional results.
- Current: Collaborating with UVM, New Hampshire DOT, and HHI to deliver multi day workshop on UAS operations and derived product creation and ingestion.

Chad Council
Regional Geospatial Coordinator
Response Division
FEMA Region I
Boston, MA 02110
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Region I UAS Guide

Draft Version 0.3

January 20, 2017

FEMA

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RECORD OF CHANGES

Change No.	Level of Recommended Change	Summary of Recommended Change	Date Entered	Posted By	Status of Recommended Change
1	Major	Initial Revision	11/16/16	Chad Council	In Review
2	Moderate	Peer review revisions	1/20/2017	Chad Council	In Review

All changes moderate or major changes must be reviewed by the Response Division Planning Branch Chief who will be responsible to assign a "Level of Recommended Change".

Minor: Any minor change to the document including grammatical or formatting changes, changes to language that clarify without altering outcome, updating of references to policy and/or doctrine. If a change is determined to be "minor", no review or approval is required.

Moderate: Any change or modification to a **tactical component** of a plan that does not result in altering outcome, or intent of the plan. (Ex. Changing a meeting time or location that does not alter the plan's outcome). If a change is determined to be "moderate", review and approval by the Division Director responsible for the publication and maintenance of the plan or procedure is required.

Major: Any change to a priority, objective or strategic component of a plan, or any other change large enough to have an effect on operations. If a change is determined to be "major", it must go through the approval process described in the Region I Plan Approval Directive.

FOREWARD

This document has been prepared to facilitate the employment of Unmanned Aerial Systems operations in Region 1 during steady state, response and recovery operations.

This Standard Operating Procedure (SOP) supports the *Region I All Hazards Plan*. The *Region I All Hazards Plan* describes how FEMA Region I will implement the National Response Framework (NRF) and the National Disaster Recovery Framework (NDRF), and this SOP corresponds to the role of GIS in that implementation.

The document presents the capabilities of various Unmanned Aerial Systems, the challenges and restrictions for employing them, and how the collected products can be leveraged to support disaster response and recovery.

Questions, comments, and suggested improvements related to this document are encouraged. Inquiries, information and requests for additional information should be directed in writing to Director, FEMA Region I, Response Division, 99 High Street, Boston, MA 02110-2132.

_____ _____

Paul F. Ford Date
Regional Administrator

TABLE OF CONTENTS

Contents

I. INTRODUCTION

A. Purpose, Applicability and Scope

This guide has been developed for use during steady state and in both the Regional Response Coordination Center (RRCC) as well as Joint Field Offices (JFO) throughout New England. It has been designed to provide Situation Awareness Section Chiefs and GIS Unit Leaders with the information required to match available Unmanned Aerial System capabilities with operational requirements.

B. Authorities and Foundational Documents

This guide supports Annex B, Appendix 3, Geospatial Appendix, to the Region I All Hazard Plan. This guide also aligns with the FEMA Geo Guide, an agency wide document that details the way in which FEMA GIS implements the DHS Geospatial Concept of Operations.

II. OVERVIEW AND BACKGROUND

In 2016, FAA Part 107 regulations went into effect that make it much easier for Small Unmanned Aerial Systems (sUAS) to be used for commercial or government purposes. These are unmanned aircraft, less than 55 lbs., commonly referred to as "UAV" or "drone". This guide is intended to be used by FEMA Incident Support or Incident Management personnel to determine if specific response or recovery mission requirements can be satisfied or exceeded by leveraging the unique capabilities offered by sUAS.

Notable new capabilities provided by sUAS include:

- High resolution aerial still photos and video can be captured
- Capable of transmitting live video feed of disaster areas to ground-station (video screen, mobile phone)
- Orthoimage / mosaic imagery derived from those images
- Rapid processing of imagery such as Geotagged still images available immediately upon aircraft landing
- Acquisition below cloud cover offers more collection opportunities
- Digital Elevation/Surface models
- 3D models derived from point clouds capable of providing volumetric calculations for areas within the imagery (e.g. road washout, debris pile)
- Operating cost is lower than manned aircraft
- Operating cost is lower than high resolution satellite imagery
- Operational tempo at which they can be fielded, provide advantages in some specific scenarios to satellite and airframe-based collection

Notable limitations:

- Area covered is smaller than piloted aircraft or satellite imagery
- Difficult or impossible to operate in rainy and windy conditions.
- Civilian discomfort with and mistrust of sUAS systems.
- Legal restrictions on range under FAA regulations – cannot be operated at night or outside of line of sight, without special exemption.
- Limited battery life, especially in multirotor sUAS models.
- Risk of radio signal and other electromagnetic interference causing crashes and/or interfering with image accuracy and quality.

There are established Region I sUAS teams affiliated with commercial, state and educational institutions that may be producing products that Region I can leverage for the federal response. Lastly, other federal agencies also offer sUAS capabilities that can be tasked through Mission Assignment.

III. ORGANIZATION AND RESPONSIBILITIES

The responsibility for establishing and maintaining this guide and the processes described within fall to the FEMA Region I Geospatial Coordinator, in coordination with the Air Operations Branch Chief.

Correspondence regarding the use of UAS at Region I may be directed towards the following key personnel:

- Chad Council: Regional Geospatial Coordinator. Chad.council@fema.dhs.gov , 617-956-7608
- Lauren McLane: Response Division / Planning Branch Chief Lauren.McLane@fema.dhs.gov, 617-956-7575
- Tim Looby: Air Operations Branch Timothy.Looby@fema.dhs.gov, 617-832-4734

IV. PROCEDURES

A. Validate Need

The first and most important step in deciding to utilize sUAS is to match the specific sUAS capability to a mission requirement and then to compare the availability, cost, and risk to conventional platforms that might be employed for the mission requirement.

FEMA program areas that may benefit from sUAS unique data capability include:

- Precision debris volume estimation
- Coastal erosion extent

- Enhanced Preliminary Damage Assessment or Infrastructure Integrity Inspection of :
  - Buildings
  - Dams and surrounding area
  - Bridges (including the underside)
  - Water Treatment Plants
  - Breakwaters
  - Harbors

B. Match Tool To Need

The second step in deciding to utilize sUAS is to match the sUAS tool to the defined mission need. Specific considerations include, but are not limited to:

- Size of the Area of Interest: Can it be captured with the sUAS available?
- Does the sUAS capture the correct data for the mission need:
  - Live streaming video
  - Geotagged photos
  - Georeferenced ortho-mosaic
  - Digital Elevation Model
  - Photographic 3D model capable of supporting volumetric calculations
- Can FEMA consume and work with the output from the service provider?
- Is the local Authority Having Jurisdiction already conducting this effort with their own tools, and is there a potential to leverage their data?
- Can FEMA partners, particularly municipalities, consume the products produced by UAS with currently available resources and training?

For more detailed information on matching the tool to the mission requirements, refer to **Appendix A: UAS Capability Reference**.

C. Review Viability of Mission

Review the following issues to determine viability of a sUAS mission.

- Weather: Can sUAS operate in current or near future conditions?
- Availability: Are there qualified sUAS teams available for the mission?
- What is the topography of the area to be surveyed? What factors might impact the quality of image matching for photogrammetry/orthomosiac collection (bodies of water, snow)?
- Is there a plan to educate communities about what will be done with the sUAS, reducing distrust/apprehension about activities?
- What is the legal plan if sUAS picks up evidence of illegal activity?

- Is there a concentrated population in the AOI? If so, what can be done to inform the population about the intended activity?
- Can the sUAS team operate safely?
- Are there factors that might impede radio communication with the sUAS (electromagnetic interference, rock, tree stands)?
- Can UAS teams be responsibly deployed in close enough proximity to relevant observable phenomena and maintain LOS (line of sight) management of the flight mission.
- Is there an impact to Operational Security?
- Air Operations support:
  - Is the AOI in Class G airspace?
  - Can Air Operations support waivers and coordination for other Classes of air space?
- What haven't you considered?

To begin a sUAS mission, refer to **Appendix B: Operational Checklist.**

D. Continued Coordination

Once a tool has been identified that meets the defined task and has been determined to be available, continue to coordinate with all parties involved to the extent required. This may include:

- Providing geospatial products to define or illustrate the Area of Interest (AOI)
- Follow through with receipt of collected imagery
- See that the products are delivered to the necessary staff in a format that they can consume and leverage to meet the mission need.
- Evaluate utility and impact of products for target partner communities and their ability to absorb these products into their response activities and workflows.

E. Spontaneous UAS Operations

An event may generate "spontaneous UAS operations" by private citizens. If so, the following guidelines should be followed:

- Evaluate the volume of spontaneous sUAS data relative to personnel available to review or leverage. Are there FEMA resources available to review the produced content?
- Consider matching available tool to the task: Review available products and determine if they provide any of the defined capabilities.
- Can you verify or reasonably infer that the imagery was collected at the stated time and location as to be pertinent to the disaster?
- Consider the sources.

- What mechanisms and authority does FEMA and/or other agencies have to discourage, prohibit, and/or limit spontaneous sUAS flights during disaster? In what contexts would these strategies need to be potentially employed?

V. GLOSSARY & ACRONYMS

AHJ: Authority Having Jurisdiction

AOI: Area of Interest

Drone: Colloquial term for unmanned aerial vehicle.

EXIF: Exchangeable Image File: The metadata standard for digital images

FEMA: Federal Emergency Management Agency

FMV: Full Motion Video that adheres to the MISB standard for georeferencing video.

Geotagged: When electronic media (photos, video, etc.) have latitude and longitude data embedded in their metadata/EXIF.

Georeferenced: For aerial imagery, when the imagery contains metadata that can display the imagery in GIS software so that it is adjusted to the corresponding location on the earth.

GIS: Geographic Information System

Metadata: For electronic media, the portion of a file that stores attributes defining the media.

MISB: Motion Imagery Standards Board

NADIR Imagery: Photos of the ground taken from an aircraft straight down

Oblique Imagery: Photos of the ground taken from an aircraft at an angle

Orthophoto: Aerial photograph or image geometrically corrected such that the scale is uniform: the photo has the same lack of distortion as a map

sUAS: Small Unmanned Aerial System

UAV: Unmanned Aerial Vehicle

Appendix A: UAS Capability Overview (sample)

Team	Type	Collection Area / Flight Time	Timing: Activation to Product	Geotagged Ortho Stills	Ortho Mosaic	Video	Ortho FMV	Geotagged Oblique Stills	Point Cloud	Notes
UVM	eBee	20 acres	8 hours	Upon landing	4 hours	n/a	n/a	n/a	Yes	Volume calculations
UVM	Quad	20 minutes	8 hours	n/a	n/a	Streaming and recorded	n/a	n/a	n/a	Upward facing camera available

Appendix B: Operational Checklist

TBD: To be created by FEMA Region I and Signal Program at HHI

PRIVACY THRESHOLD ANALYSIS (PTA)

This form is used to determine whether a Privacy Impact Assessment is required.

Please use the attached form to determine whether a Privacy Impact Assessment (PIA) is required under the E-Government Act of 2002 and the Homeland Security Act of 2002.

Please complete this form and send it to your component Privacy Office. If you do not have a component Privacy Office, please send the PTA to the DHS Privacy Office:

Senior Director, Privacy Compliance
The Privacy Office
U.S. Department of Homeland Security
Washington, DC 20528
Tel: 202-343-1717

PIA@hq.dhs.gov

Upon receipt from your component Privacy Office, the DHS Privacy Office will review this form. If a PIA is required, the DHS Privacy Office will send you a copy of the Official Privacy Impact Assessment Guide and accompanying Template to complete and return.

A copy of the Guide and Template is available on the DHS Privacy Office website, www.dhs.gov/privacy, on DHSConnect and directly from the DHS Privacy Office via email: pia@hq.dhs.gov, phone: 202-343-1717.

PRIVACY THRESHOLD ANALYSIS (PTA)

SUMMARY INFORMATION

Project or Program Name:	**FEMA Unmanned Aircraft Systems (UAS) Program**		
Component:	Federal Emergency Management Agency (FEMA)	**Office or Program:**	Regional Offices
Xacta FISMA Name (if applicable):	Click here to enter text.	**Xacta FISMA Number (if applicable):**	Click here to enter text.
Type of Project or Program:	**Program**	**Project or program status:**	**Operational**
Date first developed:	**June 14, 2017**	**Pilot launch date:**	**September 1, 2017**
Date of last PTA update	Click here to enter a date.	**Pilot end date:**	Click here to enter a date.
ATO Status (if applicable)	Choose an item.	**ATO expiration date (if applicable):**	Click here to enter a date.

PROJECT OR PROGRAM MANAGER

Name:	Michael Rizzo		
Office:	**FEMA Region 3**	**Title:**	Regional Counsel
Phone:	**215-931-5604**	**Email:**	Michael.rizzo@fema.dhs.gov

INFORMATION SYSTEM SECURITY OFFICER (ISSO) (IF APPLICABLE)

Name:	Click here to enter text.		
Phone:	Click here to enter text.	**Email:**	Click here to enter text.

SPECIFIC PTA QUESTIONS

1. Reason for submitting the PTA: New PTA

This PTA is being submitted to document the Federal Emergency Management Agency's (FEMA) use of Unmanned Aircraft Systems (UAS) to support the agency's missions including: consequence management for events of national significance; disaster response; recovery; and mitigation efforts. FEMA will not use the data provided by UAS operations to identify individuals, monitor population movement, or gather personal data. Surveillance of individuals will not occur. Any collection of personally identifiable information (PII) is incidental and will not be used by FEMA in any agency processes or for operational purposes.

Currently, neither FEMA headquarters nor any Regional office owns UAS. FEMA's UAS project will focus on obtaining imagery data through: (1) mission assigning another Federal agency that owns/operates UAS; (2) cooperative agreements with State/local governments that own/operate UAS; and (3) contracting with private sector UAS owner/operator(s). FEMA intends to consider purchasing UAS in the future, however this will not change the information collection or usage as described in this PTA. Any variations will be documented on a separate PTA and PIA as needed.

FEMA seeks to enhance its ability to obtain remote data from entities that own/operate UAS in order to fulfil many mission requirements. UAS technology possesses the ability to significantly expand FEMA's ability to obtain remote data critical to fulfilling many mission requirements with less cost, less environmental impact, and enhanced safety when compared to other conventional methods (e.g., manned aircraft). UAS also promotes safety and reduces risks to employees engaging in potentially dangerous operations, particularly for emergency responders during rapid response and situational awareness missions.

FEMA has primary responsibility for the coordination of federal emergency planning for the consequence management of catastrophic events and for National Special Security Events (NSSEs). NSSEs include but are not limited to: political inaugurations; major sporting events; national summits; and distinguished visitor receptions. In this role, FEMA will coordinate with other Federal agencies, state and local emergency managers, and private sector partners to develop consequence management plans. As part of this planning process, images and videos of buildings and infrastructure may be used to develop plans, and to provide situational awareness during NSSE. FEMA will not use the images to identify individuals or provide an identifiable link to individuals.

Data that FEMA may solicit includes both still images and videos of areas affected by disasters and/or areas that will host an NSSE. These images and videos may include debris, buildings, and infrastructure damaged during disasters and buildings and infrastructure critical to consequence management for NSSEs. Data provided by UAS operations will not be used to identify individuals, monitor population movement, or gather personal data. Surveillance of individuals will not occur. Any collection of images or videos containing individuals or PII (e.g., license plates, building numbers) will be incidental and not used to identify individuals or used in any FEMA processes or for operational purposes.

During and after a disaster, these images and videos will be used to determine the extent of damage (debris fields, flood inundation extents, fire lines, etc.), and to conduct critical infrastructure facility inspections on dams, bridges, power generation plants, etc. affected by disasters. Additionally, imagery collected by UAS operations may also be used to generate GIS product derived from the imagery such as

area of impact zones, change detection, or other post processed imagery products as directed by leadership.

Additionally, UAS imagery may be used to expedite and support Preliminary Damage Assessments (PDA) of the number of disaster impacted homes, buildings, debris, bridges, dams, water and wastewater treatment plants, power distribution systems, and other public and private infrastructure. UAS imagery obtained during a PDA would also be used to provide situational awareness concerning evacuation routes, safety concerns (including "no go" locations), and perimeter of area affected.

Use of UAS data in PDA's and disaster response and recovery efforts allows for more rapid survey of damage in areas that are inaccessible or difficult to access by personnel on the ground and by more traditional manned aircraft. Use of UAS data aligns with FEMA's mission by providing data that allows speedy decision making in order to provide life-saving and life sustaining assistance to survivors.

Additionally, UAS imagery will be used in risk map operations and land use planning analyses as part of disaster mitigation. Imagery will help determine high water marks, assist with inspections of dams and other large public works, and may provide input on potential loss avoidance measures. UAS imagery will also assist in identifying changes in the floodplain since the last Flood Insurance Rate Map and associated depth and velocity studies.

Finally, UAS imagery may be used to ensure compliance with environmental and historic preservation requirements. This may include using data to determine areas of potential effects, connected and cumulative effects, and to ensure that FEMA-funded activities across program areas abide by the requirements of the National Environmental Policy Act, the Endangered Species Act, the Historic Preservation Act and other applicable laws and regulations. Additionally, this data may be used for post-mitigation quality checks to verify that Mitigation efforts have achieved their intended purpose. These activities are not linked to individuals, focusing instead on infrastructure only.

Other proposed uses of UAS data at FEMA include:

- Hazard identification and assessment
- Debris estimations
- Critical infrastructure assessments
- Hazardous materials identification
- Situational awareness
- Assessment of erosion, fire and mudslides
- Search and Rescue
- Mitigation efforts

FEMA may use UAS data in support of Federal, State, Tribal, and local governments during disaster incidents and may share UAS data obtained with any of these entities for purposes of providing situational awareness and aiding emergency response efforts. In these instances, data may be shared under a cooperative agreement or during cooperative operations with these entities and may include still images, video feeds, or download video recordings that may be shared with authorized officials. Recipients of

data gathered by UAS are subject to Federal policy, regulations, and any future DHS/FEMA policy governing use of UAS data. Data collected during the use of UAS missions will be stored and retained in accordance with the FEMA records disposition schedule.

2. Does this system employ any of the following technologies: *If you are using any of these technologies and want coverage under the respective PIA for that technology please stop here and contact the DHS Privacy Office for further guidance.*	☐ Closed Circuit Television (CCTV) ☐ Social Media ☐ Web portal[1] (e.g., SharePoint) ☐ Contact Lists ☒ None of these

3. From whom does the Project or Program collect, maintain, use, or disseminate information? *Please check all that apply.*	☐ This program does not collect any personally identifiable information[2] ☒ Members of the public ☐ DHS employees/contractors (list components): ☐ Contractors working on behalf of DHS ☐ Employees of other federal agencies

4. What specific information about individuals is collected, generated or retained?

[1] Informational and collaboration-based portals in operation at DHS and its components that collect, use, maintain, and share limited personally identifiable information (PII) about individuals who are "members" of the portal or "potential members" who seek to gain access to the portal.

[2] DHS defines personal information as "Personally Identifiable Information" or PII, which is any information that permits the identity of an individual to be directly or indirectly inferred, including any information that is linked or linkable to that individual, regardless of whether the individual is a U.S. citizen, lawful permanent resident, visitor to the U.S., or employee or contractor to the Department. "Sensitive PII" is PII, which if lost, compromised, or disclosed without authorization, could result in substantial harm, embarrassment, inconvenience, or unfairness to an individual. For the purposes of this PTA, SPII and PII are treated the same.

Data collected through the use of UAS for FEMA disaster-related operations consists of still images, videos, and sensor or radar data may include images of buildings, vehicles and other infrastructure. While not solicited, there is a possibility of incidental collection of images and video of individuals or other PII (license plates, house numbers). This information will not be used in any FEMA process or for any operational purposes.

4(a) Does the project, program, or system retrieve information by personal identifier?	☒ No. Please continue to next question. ☐ Yes. If yes, please list all personal identifiers used:
4(b) Does the project, program, or system use Social Security Numbers (SSN)?	☒ No. ☐ Yes.
4(c) If yes, please provide the specific legal basis and purpose for the collection of SSNs:	N/A
4(d) If yes, please describe the uses of the SSNs within the project, program, or system:	N/A
4(e) If this project, program, or system is an information technology/system, does it relate solely to infrastructure? *For example, is the system a Local Area Network (LAN) or Wide Area Network (WAN)?*	☒ No. Please continue to next question. ☐ Yes. If a log kept of communication traffic, please answer the following question.
4(f) If header or payload data[3] is stored in the communication traffic log, please detail the data elements stored.	
N/A	

5. Does this project, program, or system connect, receive, or share PII with any other DHS programs or systems[4]?	☒ No. ☐ Yes. If yes, please list: Click here to enter text.

[3] When data is sent over the Internet, each unit transmitted includes both header information and the actual data being sent. The header identifies the source and destination of the packet, while the actual data is referred to as the payload. Because header information, or overhead data, is only used in the transmission process, it is stripped from the packet when it reaches its destination. Therefore, the payload is the only data received by the destination system.

[4] PII may be shared, received, or connected to other DHS systems directly, automatically, or by manual processes. Often, these systems are listed as "interconnected systems" in Xacta.

6. Does this project, program, or system connect, receive, or share PII with any external (non-DHS) partners or systems?	☐ No. ☒ Yes. If yes, please list: No PII is solicited, however images shared may contain images/videos containing individuals or PII (e.g. license plates, building numbers). FEMA may share with Federal, State, Tribal, and local governments in support of disaster recovery and response operations.
6(a) Is this external sharing pursuant to new or existing information sharing access agreement (MOU, MOA, LOI, etc.)?	Each instance of sharing will require its own ISAA.
7. Does the project, program, or system provide role-based training for personnel who have access in addition to annual privacy training required of all DHS personnel?	☒ No. ☐ Yes. If yes, please list:
8. Per NIST SP 800-53 Rev. 4, Appendix J, does the project, program, or system maintain an accounting of disclosures of PII to individuals/agencies who have requested access to their PII?	☒ No. What steps will be taken to develop and maintain the accounting: ☐ Yes. In what format is the accounting maintained:
9. Is there a FIPS 199 determination?[4]	☐ Unknown. ☒ No. ☐ Yes. Please indicate the determinations for each of the following: Confidentiality: ☐ Low ☐ Moderate ☐ High ☐ Undefined Integrity: ☐ Low ☐ Moderate ☐ High ☐ Undefined Availability:

[4] FIPS 199 is the Federal Information Processing Standard Publication 199, Standards for Security Categorization of Federal Information and Information Systems and is used to establish security categories of information systems.

	☐ Low ☐ Moderate ☐ High ☐ Undefined

PRIVACY THRESHOLD REVIEW

(TO BE COMPLETED BY COMPONENT PRIVACY OFFICE)

Component Privacy Office Reviewer:	**Brian D. Tjarks**
Date submitted to Component Privacy Office:	**September 6, 2017**
Date submitted to DHS Privacy Office:	Click here to enter a date.

Component Privacy Office Recommendation:
Please include recommendation below, including what new privacy compliance documentation is needed.

FEMA will use UAS to support the agency's missions including: consequence management for events of national significance; disaster response; recovery; and mitigation efforts. FEMA does not own UAS, and will gather data by mission assigning or information sharing with other agencies. Data provided by UAS operations will not be used to identify individuals, monitor population movement, or gather personal data. Surveillance of individuals will not occur. Any collection of personally identifiable information (PII) is incidental and will not be used by FEMA in any agency processes or for operational purposes.

FEMA recommends that while this system does not actively collect PII, it is otherwise privacy-sensitive and a FIPPs PIA should be completed for public transparency.

No retrieval will be made using a personal identifier, so SORN coverage is not required.

(TO BE COMPLETED BY THE DHS PRIVACY OFFICE)

DHS Privacy Office Reviewer:	(b)(6)
PCTS Workflow Number:	**1150978**
Date approved by DHS Privacy Office:	November 15, 2017
PTA Expiration Date	November 15, 2018

DESIGNATION

Privacy Sensitive System:	Yes If "no" PTA adjudication is complete.

Category of System:	IT System If "other" is selected, please describe: Click here to enter text.
Determination:	☐ PTA sufficient at this time. ☐ Privacy compliance documentation determination in progress. ☐ New information sharing arrangement is required. ☐ DHS Policy for Computer-Readable Extracts Containing Sensitive PII applies. ☐ Privacy Act Statement required. ☒ Privacy Impact Assessment (PIA) required. ☐ System of Records Notice (SORN) required. ☐ Paperwork Reduction Act (PRA) Clearance may be required. Contact your component PRA Officer. ☐ A Records Schedule may be required. Contact your component Records Officer.
PIA:	**New PIA is required.** If covered by existing PIA, please list: Click here to enter text.
SORN:	Choose an item. If covered by existing SORN, please list: Click here to enter text.

DHS Privacy Office Comments:
Please describe rationale for privacy compliance determination above.

FEMA is submitting this PTA to discuss the use of Unmanned Aircraft Systems (UAS) to support agency missions. FEMA does not own any UAS, and will focus on obtaining imagery through agreements or contracts with other federal agencies, state or local governments, or private sector operators.

The proposed use of UAS will expand FEMA's ability to obtain remote data critical to fulfilling many mission requirements, and could possibly involve incidental collection of PII from any individual in the surveyed area, including members of the public, DHS employees and contractors, and employees of other agencies. FEMA will not use any possible incidental PII in any FEMA process or for any operational purpose, and any use of FEMA UAS feeds by other agencies or state/tribal/territorial/local authorities will be done under that entity's privacy documentation.

However, risks remain, particularly since FEMA will not be using their own UAS but will be acquiring imagery from an array of sources. Because the capability of capturing PII exists, FEMA needs to demonstrate the steps taken that would mitigate the risk to privacy.

The DHS Privacy Office agrees that FEMA's use of UAS is privacy-sensitive and requires a PIA to fully discuss the following: 1) the details of proposed use of UAS; 2) the possible collection, maintenance, and use of imagery that could contain PII; 3) steps taken to mitigate the privacy risk involved in incidental collection of images or videos containing individuals or PII; 4) the mitigation of privacy risks associated

with FEMA's use of UAS owned and operated by other entities and sharing data with other entities; 5) steps taken to mitigate the risk that data could be used for something other than disaster response.

Additional details to be covered in the PIA:

1) What is the height range of operation?
2) What kind of zoom capability?
3) Could a UAS feed conceivably capture enough information to link an individual to their address, or enough information to provide an image of an individual's face?
4) Where is the information collected by UAS going? (i.e. is it being transferred from the source UAS to a particular FEMA system?)
5) How will locations be correlated with imagery? (i.e., how will the images collected be connected to actual locations?)
    a. Circumstances may require use of FEMA UAS-acquired images to help identify or locate individuals
6) Is there a possibility that video could be used to substantiate claims?
7) What kind of possible technology payloads could be attached to FEMA UAS? (e.g. radar, thermal imaging, radio frequency sensors)
8) Scenarios such as a request from federal/SLTT LEAs to re-task FEMA UAS that are already in flight in order to support a LE operation

FEMA will also need to publish an annual report providing details of all UAS operations performed by other agencies for FEMA, including: mission assigning UAS that are owned/operated by other federal agency; cooperative agreements with SLTT governments that own/operate UAS; and contracting with private UAS owner/operator. In addition, any future FEMA purchase of UAS would necessitate that documents be updated to indicate ownership and provide specifics on the airframes and sensors purchased.

This PTA will expire in one year. Two additional years of coverage will be provided upon completion of a FEMA-specific UAS PIA.

U.S. Department of Homeland Security
Washington, DC 20472

FEMA

MEMORANDUM FOR: Regional Administrators

FROM: Damon C. Penn
Assistant Administrator for Response

SUBJECT: Use of Unmanned Aerial Systems for Situational Assessment

Purpose
This document provides information regarding the potential use of Unmanned Aerial Systems (UAS).

Background
FEMA analysts routinely use imagery collected by manned aircraft and satellites for situational awareness and geospatial damage assessments. However, since the 2016 release of Federal Aviation Administration (FAA) rules[1] allowing small UAS operations in national airspace, Whole Community members have begun incorporating UAS platforms into Response and Recovery operations.[2]

Discussion
The FEMA Geospatial Information Officer is my designated lead for coordinating an Agency approach to integrating remotely sensed data and imagery from UAS.

There is no current DHS or FEMA contract vehicle for acquiring UAS data or services from vendors. However, FEMA Response personnel may mission assign UAS-equipped federal partners, including the Department of Defense, U.S. Customs and Border Protection, U.S. Department of the Interior, and the United States Army Corps of Engineers. Available sensors include daylight or low-light cameras, still image or video cameras, and more technical equipment such as multispectral, infrared, or light detection and Ranging (LiDAR) sensors. FEMA Incident Management and Incident Support organizations may procure through the Mission Assignment process UAS services and data to support both Situational Assessment and Emergency Support Function-specific requirements.

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[1] FAA Advisory Circular (AC) 107-2 provides guidance in the areas of airman (remote pilot) certification, aircraft registration and marking, aircraft airworthiness, and the operation of small Unmanned Aircraft Systems (sUAS) in the National Airspace System (NAS) to promote compliance with the requirements of Title 14 of the Code of Federal Regulations (14 CFR) Part 107, Small Unmanned Aircraft Systems.

[2] FEMA Region IV mission assigned a U.S. Army Corps of Engineers small UAS team to monitor dams of concern in the South Carolina floods of 2015. In 2017, FEMA's Geospatial Information Officer mission assigned the Department of the Interior to provide small UAS teams for Urban Search and Rescue support during Hurricane Harvey, and Region IV leveraged Customs and Border *Protection's Predator* UAS during Hurricane Irma.

UAS are well suited for certain missions, including:

- Aerial imaging in remote, contaminated, hazardous, or dangerous areas that pose significant risks to aircraft crews or ground personnel.
- Tactical search and rescue or victim recovery operations that require dynamic, near-real-time observation systems.
- Missions that require long-dwell observation platforms (select, large UAS).
- Missions that require very high-resolution imagery (less than 5 centimeters).

While UAS technology is promising, it remains only one tool in an emergency manager's toolbox. Small UAS, as defined and authorized by recent FAA rule changes, remain hampered by power, data storage, and operational constraints [3] and may not be suitable for every situation or information requirement.

The specific imagery collection platform shall be determined based on the most effective and efficient means of accessing and operationalizing the imagery or data. For instance, broad area imagery collection may be best achieved by multiple Civil Air Patrol aircraft or satellites and sustained night imaging may best be performed by properly equipped, manned aircraft. All UAS imagery shall be obtained in a manner that ensures its accessibility across the response and recovery enterprise in conjunction with other GIS information. Mission assignments shall include the following statements:

- UAS shall not be used for the express purpose of collecting Personally Identifiable Information (PII). UAS imagery will be screened for PII and any incidental collection of PII will be purged, masked, or appropriately marked and controlled by FEMA personnel.
- UAS operators shall be responsible for ensuring legal and safe operations in accordance with all applicable FAA rules.
- UAS-collected data will be unlicensed and publicly releasable or otherwise marked and appropriately controlled.
- UAS-collected data will not be used for compliance or regulatory purposes.
- FEMA-sponsored UAS images will be uploaded to the FEMA Image Uploader or distributed as Open Geospatial Consortium-compliant image services for consumption by FEMA GIS applications.

Agency coordination and access to UAS capabilities will be an agenda item for monthly FEMA Geospatial Working Group (GWG) meetings and during daily incident geospatial coordination calls when required.

[3] Per FAA website as of 15 March, 2018, small unmanned aircraft must: weigh less than 55 pounds, including payload, at takeoff; fly in Class G airspace*; remain within visual line-of-sight of pilot*; fly at or below 400 feet*; fly only during daylight or civil twilight*; fly at or under 100 mph*; yield right of way to manned aircraft*; not fly directly over people*; not fly from a moving vehicle, unless in a sparsely populated area* (An * denotes a waiverable limitation.)

For further information, please contact Christopher Vaughan, Geospatial Information Officer, (202) 740-3037 or email christopher.vaughan2@fema.dhs.gov.

cc: Alex Amparo, Recovery Directorate, Assistant Administrator

UNMANNED AERIAL SYSTEMS FOR SITUATIONAL AWARENESS

UAS Program

GIS Office, Response Planning, Planning and Exercise Division

FEMA

Geospatial Information Officer

FEMA

Subject: Use of Unmanned Aerial Systems for Situational Awareness, 13 MAR 2018

Designated by Associate Administrator for Response memo

-- 13 March 2018

- Designated GIO as his "lead for coordinating Agency approach to integrating imagery and data from UAS"
- Mr. Vaughan tasked 2-person team to assist him with development of UAS data integration strategy
- a.k.a "FEMA UAS Program"
- Focusing on UAS-obtained data that enhances Situational Awareness for Response

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Response's Current Approach to UAS

- Already employing it for SA (USACE in SC, DOI in Harvey, CBP in Irma)
- No current contracting vehicle for acquiring commercial UAS data
- Well-suited for certain missions:
  - Remote locations
  - Dangerous or contaminated air space
  - Dynamic, near real time requirements
  - Long-dwell or near-persistent requirements
  - Highest resolution data
- UAS is one tool in the SA toolbox (necessary vs. nice-to-have)
- Individual privacy will be protected (PII)

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Potential Benefits for Field Units

- Collect video imagery, still imagery, LiDAR, data for 3d Point Clouds, MSI, FLIR, etc.
- More-timely data collection (if on-hand or locally available)
- Real-time/near real-time data dissemination (depending on system, sensor, comms package)
- Lower costs
- Can potentially/eventually be used for more than SA
  - Delivery of life-saving/sustaining equipment
  - Communications and messaging (Wifi, leaflets, audio broadcasts, etc.)
  - Logistics

Discussion:

What are IMATs' information requirements and UAS use cases?

Other Field units that can benefit? US&R, etc.

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Federal UAS Programs

DOI	3DR Solo Quadcopter .8KM 25 Mins 	Pulse Vapor 55TM 9KM 60 Mins 	Fixed Wing Falcon 30-60 Miles 60+ Mins 	Falcon Hover .8km 25 Mins 

CAP, CBP, NASA, DoD, DOI, NASA, USACE

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Challenges for Field Units

- Courses of Actions: Own, Mission Assign, Contract, Reimburse, or Leverage
- Privacy/Public Perception and Pushback
- Safety
- Liability (Personal and Agency)
- sUAS Technical Limitations (battery, weather, time/distance, etc.)
- FAA restrictions:
  - Option 1: Part 107: (Visual Line of Sight, dawn to dusk, 400 foot operational ceiling, operations near airports, maximum speed, weight, pilot certification, etc.
    - Some restrictions can be waived
  - Option 2: Obtain a blanket public Certificate of Waiver or Authorization (COA) –
    - Permits nationwide flights in Class G airspace
    - At or below 400 feet
    - Self-certification of the UAS pilot
    - Option to obtain emergency COAs (e-COAs) under special circumstances
    - Option 3: Section 333: UAS over 55 pounds, pilot requirements: case-by-case
  - Training, Credentialing, Typing of UAS teams and pilots
  - Standardization of data and providers
  - Data transmission, analysis, storage, disposition
  - State and local laws

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UAS Program Goals

- Enable vs. interfere with ongoing Regional UAS initiatives
- Be cross-cutting: Involve all FEMA mission areas, programs, and directorates
- Host monthly stakeholder sessions (MDWG, etc.)
- Interact with Interagency, Academia, Industry and partners
- Develop and share inventory of federal UAS capabilities
  - NLT than 1 June
  - Develop PSMAs and CONOPS so field units can leverage them, if desired
- Develop "UAS Data Integration" Program Plan NLT 1 SEP 2018
  - Mission Analysis: SA Data Collection
  - Develop and Analyze Alternative UAS Solutions, to include ROM Costs
  - Provide UAS-related Recommendations to AA for Response and other FEMA leadership, as required

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Questions

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