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EDC-5 UAS Peer-to Peer Exchange

South Dakota Department of Transportation

Iowa Department of Transportation

Ames, Iowa

October 6, 2021



U.S. Department
of Transportation
**Federal Highway
Administration**

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Background

Unmanned Aircraft Systems (UAS) usage is increasing among State Departments of Transportation (State DOTs). The Federal Highway Administration (FHWA) has coordinated efforts to assist with the adoption and use cases through the FHWA EDC-5 UAS initiative. The FHWA sponsored a peer exchange between the South Dakota DOT and the Iowa DOT. South Dakota DOT was in the nascent stages of implementing a UAS program and requested a peer exchange with Iowa DOT to learn from its implementation. This report summarizes the information presented by the South Dakota and Iowa DOTs which was current and accurate at the time of the peer exchange held on October 6, 2021.

Iowa DOT UAS Program

Overview

Iowa DOT started its initial UAS program in 2016. Iowa DOT aviation employees stated that they were among the first certified remote pilots in the State. The following primary use cases were discussed:

- Supplemental bridge inspections.
- Light towers inspections.
- Aerial mapping.
- Quantity calculations.
- Public engagement.
- Earth movement.
- Rockfall assessment.
- Facility maintenance.
- Wetland mitigation.

Iowa's UAS leadership team met with each Iowa DOT district to offer assistance and inquire about its interest in using UAS. If there was interest, each Iowa DOT district was required to name individuals to participate in the UAS user group. The Iowa DOT Aviation Bureau worked to complete policy and procedures that best fit its organization for a successful program and mitigate risk. The latest revision to these documents was approved in January 2019.

Organizational Structure

The Iowa UAS program is regulated by the Iowa Aviation Bureau. When regulatory changes occur, the Iowa Aviation Bureau disseminates relevant information to the Iowa DOT districts utilizing UAS. The Iowa UAS user group participants also serve as primary contacts for UAS-related matters for the district they represent. The user group meets multiple times each year to help improve the program and innovate the processes. Authority for policymaking resides with the Aviation Bureau.

Pilot Requirements

Iowa DOT presented its pilot requirements for conducting UAS operations. Iowa DOT requires that its pilots have a Federal Aviation Administration (FAA) remote pilot certificate and pilots are also subject to Iowa UAS regulations, in addition to FAA's 14 CFR Part 107 – Small Unmanned Aircraft Systems regulations. Iowa DOT utilizes third-party training materials to prepare its pilots. Once its pilots have received their remote pilot license, they must complete a minimum of two hours of flight time in an uncongested area to develop proficiency for each model of aircraft prior to operating any UAS on a

Department project. Additionally, the employees must satisfactorily complete a flight review with an Aviation Bureau examiner, or other examiner designated by the Aviation Bureau to demonstrate operational knowledge and proficiency. Furthermore, Iowa DOT UAS pilots must also complete a satisfactory flight review every 24 calendar months.

Flight Review Process

Iowa DOT requires a satisfactory UAS Flight Review before its pilots can conduct operations. The flight review is intended to ensure that basic knowledge, skills, and proficiency are in place to support safe and effective UAS operations. The review includes both a demonstration of knowledge and flight proficiency. For the internal Iowa DOT flight review, the pilots are expected to have a thorough knowledge of the material. The prospective pilots cannot use notes during the review. This is to ensure that they fundamentally understand the necessary material. The main objectives for the Iowa DOT internal UAS Flight Review are to:

- Determine if the pilot is proficient and a master of the craft for operating a UAS.
- Determine if the pilot can split their attention and multitask while still operating the aircraft in a safe manner.
- Determine if Iowa DOT is comfortable with the pilot representing the Iowa DOT on various projects.

The topics covered during the flight review are divided into two sections: Knowledge and Flight Proficiency.

The knowledge section includes:

- FAA regulatory knowledge.
- Assessing weather conditions.
- UAS hardware and software understanding.
 - Firmware.
 - Charging/storing batteries.
 - Battery management.
- Privacy.
- Safety culture.
- Flight planning.

After the prospective pilot has shown proficiency in the knowledge portion, they will proceed to the flight proficiency portion of the review.

The Flight Proficiency section includes:

- Preflight.
- Setup and selection of suitable take-off and landing location.
- Confirmation of UAS control links.
- Proficiency in all phases of flight.
- Maintaining visual line of sight with aircraft during flight.
- Successfully managing distractions.
- Monitoring aircraft during flight, including battery levels.

- Ability to successfully divide attention between flying and scanning for other air traffic while maintaining a safe flight.
- Ability to operate the camera and sensors during flight.
- Ability to react appropriately during an emergency.

Iowa DOT has a dedicated area set up for flight reviews. The site provides a safe operating environment while still exposing prospective pilots to hazards/obstacles that may be encountered in a typical data collection flight. Iowa DOT does not offer an in-person training class for the flight review, instead, it provides a self-study flight review guide. The expectation is to have prospective pilots dedicate the time to study the material independently with experienced Iowa DOT UAS pilots and for the Aviation Bureau employees to also be resources for them. To fly on Iowa DOT projects, they must achieve a satisfactory pass score on the flight review. If they do not meet the requirements, prospective pilots can retake the flight review after additional practice to show improved proficiency with the material and by performing better on the practical flight portion of the review.

The complete flight review form is provided in Appendix D.

Funding Sources and Budget

Funding for the UAS program at Iowa DOT is completed through each district. Iowa DOT does not have a dedicated, centralized UAS budget.

Data Storage

UAS data collection can create large amounts of data due to the number of high-resolution photos and video that is collected. In addition to the collection, the end deliverables can also be of considerable size, which necessitates the need for large amounts of storage. Data storage is a common topic of discussion as it can put strain on an already space-limited servers. Iowa DOT presented considerations on the length of time the data should be stored, what information should be retained, and what is considered incidental after the data has been processed are key components to consider. Iowa DOT uses a cloud-based storage solution for this purpose.

Iowa DOT UAS Privacy Policy

Iowa DOT considers privacy to be paramount to successful UAS operations and care is taken to prevent filming of people or property that is not incidental to the operation. If images captured are not incidental to the data collection, the Iowa DOT UAS Privacy Policy requires a letter to be sent to landowners to notify them and to provide information on how they may receive a copy of the data. A sample letter is included in Appendix C.

Iowa DOT Use Case Presentations

Supplemental Bridge Inspections

Iowa DOT showcased multiple bridges where it used UAS for supplemental bridge inspections. The first bridge discussed was a truss bridge over the Mississippi River. The bridge had a span of over 2,000 feet and was a prime candidate for using UAS. The project scope was to identify areas where the bridge lighting required maintenance and to document any damage that may have occurred after a recent painting contract was completed. During the flight planning phase, it was decided to capture video

instead of still photos in order to provide complete coverage, prevent missed information, and make the review process easier.

Another bridge showcased was in Ames, Iowa, where Iowa DOT captured high-resolution data that showed details on each bolt of the diaphragms. Iowa DOT found that UAS helps improve productivity and saves costs associated with traditional bridge inspections. Thermal analysis was evaluated using UAS, but Iowa DOT had limited success and did not find it to be a viable solution. Multiple solutions were tested on the bridge deck, but Iowa DOT found that thermal sensors on UAS does not provide reliable results. Iowa DOT found that thermal worked best on bridge substructures rather than on bridge decks.

Light Towers Inspections

Iowa DOT has found that UAS are easier to deploy than conventional equipment for light tower inspections. Previously, Iowa DOT used specialized equipment and set up traffic control to safely operate lift-vehicles. Using UAS, Iowa DOT found it was able to see fine details and successfully inspect slip connections, welds, and the hardware of the towers. It found its best results were achieved in good lighting conditions as there were limitations when trying to capture details on the side of the poles in shadows. It found that deploying UAS can increase productivity, allowing more towers to be inspected. By increasing the frequency of inspections, issues can be identified early when it may be easier and less expensive to repair. UAS use was compared to traditional inspection methods such as using a telescope or binoculars from the highway and was found to provide a better perspective and the ability to see a higher level of detail.

Aerial Mapping

Iowa DOT started using UAS aerial imagery and data processing software to produce scaled distances off the aerial images with targets. It also used the processed images to produce 2D orthorectified images.

Prior to purchasing additional software, Iowa DOT evaluated multiple software packages. The criteria for the evaluation were based on:

- The ability to share with staff and others outside of the organization.
- Output formats.
- Ease of use.
- Cost.

Iowa DOT decided to use cloud-based processing solutions to enable processing independent of the local less powerful computers and increase the data processing speed. It also provided the ability to process from any site and not be dependent on hardware location.

Iowa DOT uses software that allows the capture of images from a mobile device to use for stockpile images. It found the accuracy of the quantities to be 85 to 93 percent accurate while providing the ability to increase productively with limited staff. To increase the accuracy of the UAS data, Iowa DOT utilized Ground Control Points. To establish ground control point targets, it used mudflaps and spray paint to create a high contrast durable target, providing a cost-effective and portable solution for control points with minimal impacts from wind and other environmental conditions.

Quantity Calculations

Quantity collection and tracking can be a laborious task. Iowa DOT wanted to find innovations with its existing process for quantities. To evaluate solutions using UAS, it decided to compare its purchased UAS data processing software with its conventional methods. Iowa DOT found discrepancies with the quantities measured of the seeding from the UAS collection during the evaluation. The quantity from the UAS collection had an increase of 0.5 acre. After evaluating further, Iowa DOT found that the data from the UAS is more accurate and plans on using UAS as the more precise solution for future calculations.

Public Engagement

Iowa DOT shared ways it has successfully used UAS for public engagement. One way was using UAS to collect aerial imagery of COVID-19 test sites. The aerial imagery was used to help the public navigate the area and understand the layout of the site. Having better visuals for the public increased the efficiency of the test sites for patrons prior to their visit.

Iowa DOT also used aerial footage taken from a UAS to show new designs and traffic patterns to the public. (Figure 1) Some specific examples included a Single Point Urban Interchange (SPUI), roundabouts, and other new interchange designs. Iowa DOT also used UAS data to provide another visual perspective of a bridge and to explain the process of an inspection during an industry association meeting.



Figure 1 – UAS footage of Iowa SPUI Interchange (Image: Iowa DOT)

Earth Movement

Another use case in which the Iowa DOT used UAS to view the backslope of a highway that had slipped, allowing crews to gather information from a new perspective and keep employees at a safe distance from the slippage area. (Figure 2)



Figure 2 - UAS Imagery of Earth Movement (Image: Iowa DOT)

Rockfall

Iowa DOT also has found UAS helpful for rockfall assessment. (Figure 3) It used UAS to capture aerial view footage to assess how many rocks were retained by the barrier. Using UAS, crews were able to efficiently view the area and document information needed to set up a project. Having aerial imagery helped the crew understand the scope of how many rocks were retained and to create a plan for removal and mitigation for future events.



Figure 3 - UAS Imagery of Rockfall (Image Courtesy Iowa DOT)

Facility Maintenance

Iowa also has used UAS for damage discovery on State DOT building maintenance. UAS pilots were able to use the UAS to inspect the Iowa DOT offices to identify damage to the roof without having personnel physically present on the roof. Through the operation, crews were able to identify areas in need of repair and determine the extent of damage following a wind event. (Figure 4) Once identified, the crews could make data-driven decisions on the best path to repair the facility.



Figure 4 - UAS Imagery of Wind Damage on Iowa DOT Building (Image Courtesy Iowa DOT)

Wetland Mitigation

Iowa DOT has been using UAS for wetland mitigation with success in multiple areas.

The use case presented was the use of UAS to acquire imagery to monitor trees planted and provide a count of trees to the U.S. Army Corps of Engineers. Iowa DOT was able to set a foundation of data and plan for additional flights to monitor over five years.

Archaeology

Iowa DOT has used UAS to map State DOT property with historic buildings on site. The UAS collection allowed data to be collected for a site assessment and provided historical documentation for each site.

South Dakota DOT UAS Program

Overview

South Dakota DOT's interest in UAS initially came from an FHWA peer exchange held in Grand Forks, North Dakota, that included Iowa, Minnesota, Montana, North Dakota, South Dakota, and Wyoming. Specifically, South Dakota became interested in incorporating UAS across multiple uses such as infrastructure inspection, emergency response, construction inspection, and asset management. South

Dakota DOT utilized resources from other State DOTs (Utah and Iowa) to help with its policy and procedures and modified them to fit its needs.

Organizational Structure

South Dakota DOT reported at the peer exchange it has been working for the past 2.5 years to set up its UAS program structure. South Dakota UAS pilots fly UAS as an additional duty to their regular workload and use UAS as a supplemental tool to their current disciplines. South Dakota DOT has utilized its UAS committee to include a cross-section of internal UAS pilots, planners, land surveyors, bridge inspection engineers, and representatives from the aviation office. A UAS committee has been established to support all agency owned UAS. Duties of the committee include:

- Support all agency owned UAS.
- Annually review and update the UAS Procedures.
- Review submitted UAS Forms and provide a recommended action.
- Facilitate training as needed.
- Maintain a list of licensed and trained pilots.
- Maintain a list of UAS Examiners.
- Review flight plans for compliance with FAA regulations when requested.
- Maintain a list of department owned UAS equipment.
- Review Certificate of Waiver or Authorization (COA) requests and the need for waivers.
- Submit new COA request to the FAA for approval.
- Annually review COAs that have been approved by the FAA.
- Review the UAS purchase proposals and provide a recommendation on whether to purchase to Division Director or designee.

The Division Director is responsible to provide approval or disapproval for all UAS purchase requests in respective divisions after review by the UAS Committee. To protect privacy for its operations, all UAS flights are limited to the specific purpose of the project with an expectation for pilots to employ reasonable precautions to avoid capturing images of the public except those that are incidental to the operation.

Flight Review

After the commencement of the Peer Exchange, South Dakota DOT has prepared its flight review procedure based on lessons learned from the Peer Exchange and other resources. The flight review documentation is provided in Appendix C.

Pilot Requirements

South Dakota DOT requires that pilots have an FAA remote pilot certificate and be governed by South Dakota UAS regulations in addition to FAA 14 CFR Part 107 regulations. All South Dakota DOT UAS pilots who are employees must also register with the SDDOT UAS Committee prior to operating a UAS. For record-keeping and documentation, the UAS pilots are required to log all flights into a logbook for tracking purposes. A copy of South Dakota DOT's procedures and guidelines for UAS operations are provided in Appendixes D and E.

Funding Sources and Budget

At the time of the peer exchange South Dakota DOT reported it does not have a dedicated budget for the UAS program.

Insurance

Insurance for the UAS program is through its existing aircraft policy. The insurance policy requires each UAS pilot to fill out a UAS Remote Pilot Record Form and for each UAS to be insured as part of the South Dakota's DOT existing aircraft policy. The UAS Insurance Application must be signed and approved by the South Dakota State Secretary of Transportation.

Data Storage

South Dakota did not have an official policy or service for the storage of UAS data at the time of the peer exchange. The UAS team was coordinating with the Information Technology (IT) department to determine the best method for the organization to store data that will be collected from UAS.

Software Used

Currently South Dakota DOT is in the evaluation stage for determining which software packages best meet its UAS program data collection and data processing goals.

Areas of Interest for UAS Operations

Additional areas of interest for evaluating UAS operations identified by South Dakota DOT are:

- In-service structure inspection.
- Emergency relief events.
- Construction-documentation of prosecution and progress and documentation of project quantities, etc.
- Work zone traffic control documentation.
- Traffic operations.
- Wetland mitigation.
- Public relations.

Flight Assessment Demonstration by Iowa DOT

Iowa DOT performed a flight assessment, both oral and a flight demonstration, for South Dakota DOT as part of the peer exchange. South Dakota expressed interest in the process to find a suitable strategy to assess its pilots. For the flight assessment, the Iowa Aviation Director walked through each step outlined in Appendix C.

The knowledge portion was completed in the classroom, along with a demonstration on the Low Altitude Authorization and Notification (LAANC) system, weather briefings, FAA regulations, and best

practices. Once the knowledge portion was reviewed, the workshop proceeded to another location in the field where Iowa DOT performs its flight assessments. South Dakota DOT used one of its UAS platforms to perform the flight demonstration portion. The Iowa Aviation Director walked through each step as the South Dakota DOT Survey Crew Chief performed the maneuvers. (Figure 5) The flight portion started with a thorough preflight of the aircraft to ensure the aircraft was air worthy and safe for flight prior to other maneuvers being performed.

Once the aircraft was launched and the elementary controls were established, a series of increasingly challenging tasks were performed to demonstrate adequate navigation to landmarks while avoiding obstacles and always maintaining positive control of the aircraft. Once the tasks were completed, the last demonstration was to land the aircraft at the designated location successfully.



Figure 5- Field Flight Assessment Demonstration (Image Courtesy South Dakota DOT)

Key Takeaways

Participants from the Iowa and South Dakota DOTs discussed the key takeaways of the peer exchange in a concluding session.

UAS Program Structure. Having a defined UAS program structure can be a key component for success as a UAS program grows within a State DOT, whether centralized or decentralized. A UAS authority can help to ensure that UAS operations within the State DOT meet the goals for a safe and efficient system that complies with FAA and other applicable regulations. Additionally, establishing UAS policies and procedures can assist UAS pilots understand the structure of the program, acceptable uses of UAS, procurement procedures, UAS pilot flight requirements, and emergency protocols. Additionally, policies and procedures may assist in the mitigation of risk associated with the use of UAS and to help provide a consistent level of proficiency across an organization.

Incorporate flight assessments and practical flight skills in addition to a remote pilot license. When a pilot first receives a remote pilot certificate, they may not have any practical experience flying UAS platforms. Iowa State DOT reports that requiring a flight assessment for its remote pilots provides the means to ensure that the UAS pilots are proficient and competent for operating UAS for State DOT missions.

Find use cases that are easy wins when starting operations. When first utilizing UAS for operations it is beneficial to begin with use cases that are easy to perform and can increase productivity such as structure inspections, aerial mapping, or public engagement photos. These use cases can be done with a relatively low-cost aircraft and provide substantial cost savings.

Engage with peers. Many State DOTs are using UAS, and it is beneficial to engage with peers for success. The FHWA has various information resources to help State DOTs build and grow a UAS program s. FHWA UAS information resources can be found at <https://www.fhwa.dot.gov/uas/>.

Appendix A: Iowa: Entering Private Property Sample Letter

As noted in the body of the report, this is a sample letter of what the Iowa DOT sends to individuals when it is required by its internal privacy procedures. Iowa DOT provided permission to share this and other materials in this report.

Office of Location and Environment
800 Lincoln Way, Ames, IA 50010
Phone: 515-239-1787 Email: Brad.Hofer@iowadot.us

April 12, 2017

Ref: Louisa US 61 one mile north of IA 78 to two miles south of IA 92
Project # NHSX-061-3(61)-3H-58

<Salutation> <First Name> <Last Name>
<Address>
<City>, <State>, <Zip>

Dear <salutation> <Last Name>:

As you are aware, the Iowa Department of Transportation is in the process of planning improvements for the proposed US 61 corridor between Iowa 78 and Iowa 92. We are nearing completion of the planning and environmental process and you should be receiving an invitation soon to participate in a public hearing in early summer.

We are also in the process of collecting survey data within the corridor to further assist design efforts and final documentation. This data will help correlate field collected data to remote sensed data. The Department of Transportation is allowed by the State Code of Iowa, Chapter 314 (excerpt below), to enter private property for the purposes of conducting surveys. In the past, we may have contacted you to gain access and conduct these field surveys on your property.

Beginning this spring, survey will include the use of small Unmanned Aircraft Systems (sUAS) to collect land survey data and aerial imagery. These aerial surveys will be conducted during daylight hours and will be much less intrusive than many of the field surveys we have conducted to date. These surveys should not require use to physically enter your property, but will require us to fly over your property predominantly between 200 feet to 400 feet above the ground. These surveys will be conducted twice this year. We hope to complete the first survey during the months of April-May and the second during June-July. Conducting surveys during different times of the year allows us to collect more complete data and better evaluate environmental characteristics in the project area.

If you are interested in the survey data collected for your property, we are happy to provide you a copy. We would request that you provide digital media for us to be able to deliver the data to you. Due to the size of this data, we'd suggest an external hard drive with at least 1TB of storage space depending on the size of your property. If you would like to discuss the data or interested in obtaining a copy, you may contact me in advance of the public hearing or we can discuss it during that event.

I would be happy to address any questions or concerns you may have or provide you with additional information as needed. Please feel free to call email me at the email address and phone number listed below or provide a response online at the following link

<http://bit.ly/iowadot96381401>

We appreciate your help and look forward to talking to you soon.

Sincerely,

State of Iowa Code 314.9 – Entering of Private Property

The agency in control of a highway may after thirty days' written notice by restricted certified mail addressed to the owner and also to the occupant, enter upon private property for the purpose of making surveys, soundings, drillings, appraisals, and examinations as the agency deems appropriate or necessary to determine the advisability or practicability of locating and constructing a highway on the property or for the purpose of determining whether gravel or other material exists on the property of suitable quality and in sufficient quantity to warrant the purchase or condemnation of the property. The entry shall not be deemed a trespass, and the agency may be aided by injunction to insure peaceful entry. The agency shall pay actual damages caused by the entry, surveys, soundings, drillings, appraisals, or examinations.

Any damage caused by the entry, surveys, soundings, drillings, appraisals, or examinations shall be determined by agreement or in the manner provided for the award of the damages in condemnation of the property for highway purposes. Soundings or drillings shall not be done within one hundred fifty feet of the dwelling house or within fifty feet of other buildings without written consent of the owner.

Appendix B: Iowa DOT UAS Guidelines



Small Unmanned Aircraft Systems (sUAS)

Guidelines

Effective: January 1, 2019

Purpose

To define the use of Small Unmanned Aircraft Systems (sUAS) for the purposes of conducting Iowa Department of Transportation (Department) business.

Guidelines

sUAS Use

- sUAS may be used to perform a wide range of Department functions.
- Employees are prohibited from using privately-owned UAS of any kind for Department business.
- Vendors are prohibited from using privately-owned UAS of any kind for Department business, unless under written agreement with the Department.
- All sUAS operations will comply with Federal Aviation Administration (FAA) Part 107 regulations involving operations, pilot certification and currency, aircraft registration, waivers/authorizations, and airworthiness standards.
- The sUAS Remote Pilot in Command (RPIC) has the final authority and responsibility for the operation, safety, and FAA Part 107 regulatory compliance of any sUAS operation. Employees or offices that require assistance complying with FAA regulations will consult with the Department's Office of Aviation.

Operational and Training Requirements

- Prior to conducting any sUAS flight on behalf of the Department, employees intending to operate as Remote Pilot in Command (RPIC) of Department-owned sUAS will notify the Office of Aviation with the following information:

Name:

Division and office:

Supervisor:

Scanned image of an FAA-issued Remote Pilot Certificate:



Information on what UAS they will fly and types of operations:

Confirmation the sUAS is registered in the Department's name with FAA:

- Prior to operating any sUAS on a Department project, FAA Part 107-certified employees must conduct a minimum of two hours of flight time in an uncongested area to develop UAS proficiency for each model of aircraft that will be flown. The employee must then satisfactorily complete a Flight Review with an Office of Aviation examiner, or other examiner designated by the Office of Aviation, to demonstrate operational knowledge and proficiency.
- Employees must subsequently complete a satisfactory Flight Review with the Office of Aviation, or other designated examiner, no less than every 24 calendar months

UAS Procurement

- Divisions and offices seeking to procure sUAS equipment will follow standard Department procurement requirements.

Contracting UAS Services

- Divisions and offices seeking to procure sUAS services will follow standard Department procurement requirements. Procurement notices and service contracts for services including sUAS operations will specify requirements to comply with all FAA Part 107 regulations. sUAS service providers contracting with the Iowa DOT will operate in strict compliance with FAA Part 107 regulations.

Protection of Individual Privacy and Personal Information

- sUAS operations will be limited to those necessary for the specific business purpose of the flight and will exercise reasonable precautions to avoid capturing images of people and private property, except for purposes provided for in Iowa Code 314.9 (entering property), and those that are incidental to the project.

Accident Reporting

- Accidents involving sUAS must be reported to the FAA and/or NTSB as required in FAA Part 107 regulations. Notification should be made to the RPIC's supervisor, and the Department's Office of Aviation, as soon as practical. In the case of sUAS service providers, notification should also be made in writing, as soon as practical to their specified contact at the Iowa DOT.

Appendix C: Iowa DOT UAS Flight Review



sUAS Flight Review

A satisfactory Small Unmanned Aircraft Systems (sUAS) Flight Review is required prior to operating any sUAS on a Department project. The flight review is intended to ensure basic knowledge, skills and proficiency are in place to support safe and effective sUAS operations, and to comply with FAA Part 107 regulations. The review includes both a demonstration of knowledge, and a demonstration of flight proficiency.

An FAA Part 107 Remote Pilot Certificate and a minimum of two hours of flight time are required prior to scheduling a flight review. Additional training and flight time may be needed to develop operational proficiency. A registered sUAS will need to be supplied by the applicant. Components of the flight review include:

Demonstration of Knowledge

- FAA Remote Pilot Certificate
 - Able to produce a certificate*
- Aircraft registration and marking
 - Understands non-hobby registration and marking requirements*
- Firmware and application updates
 - Understands importance of updating firmware and applications*
- Charging/storing batteries
 - Understands the importance of charged batteries and impact of wind in returning home*
 - Batteries should be stored where they don't make contact with metal objects*
 - Extreme temperatures impact battery performance.*
- Checking weather conditions
 - How to check local weather using approved weather source*
 - *Foreflight, NOAA, other official sources*
 - Knows weather minimum requirements*
 - *Min. 3 miles visibility, 500' below and 2,000' horizontal from clouds*
- Checking airspace and authorization requirements
 - Understands how and where to check uncontrolled vs. controlled airspace*
 - Identifies when authorizations/waivers are needed*
 - Demonstrates ability to access and operate the LAANC system i.e. Airmap*
 - Is aware of standing stadium flight restrictions in Iowa*
 - Knows how to check for Temporary Flight Restrictions (TFR's)*
 - *Understands flight prohibited without specific FAA authorization*
- Site plan/flight plan
 - Reviews site ahead of time and formulates plan for safe and effective flight*
- Part 107 regulations
 - Review random selection of Part 107 regulations*
 - Demonstrates understanding and applications to flying at the Iowa DOT*
 - *flights over people and vehicles*
 - *deviation from rules to extent necessary to address emergencies*
 - *Remote Pilot in Command (RPIC) is responsible for and has final authority*
 - *Can't act as RPIC if medical condition interferes with operation of sUAS*

- Commitment to maintaining a strong safety culture
 - Demonstrates intent for;*
 - *professionalism and making good judgements*
 - *Complying with Part 107 requirements and DOT guidelines*
 - *Maintaining recency requirements every 24 calendar months*
 - Reporting accidents immediately to supervisor*
 - Reporting accidents within 10 days to FAA*
 - *if it meets criteria of serious injury or damage over \$500*
- Respect for privacy
 - Keep flights limited to specific business purpose*
 - Reasonable precautions with photos of people and property*

Demonstration of Flight Proficiency

- Preflight inspection
- Satisfactory setup, launch point, and launch
- Confirmation of sUAS control links
- Proficiently operates the UAS in all phases of flight
- Maintains visual line of sight
- Manages distractions
- Monitors battery levels
- Division of attention between flying and scanning for traffic
- Able to operate camera during the flight
- Reacting to emergency situations i.e. lost link or visual contact

Name of applicant: _____ **Signature of applicant:** _____

Date of review: _____ **Model of aircraft flown:** _____

This applicant has satisfactorily completed the sUAS flight review.

Name of reviewer: _____ **Signature of reviewer:** _____

Date of review: _____

Comments:

Appendix D: South Dakota DOT UAS Procedures

South Dakota DOT provided permission to share this and other materials in this report.



DEPARTMENT OF TRANSPORTATION

Department of Transportation

700 E Broadway Avenue
Pierre, South Dakota 57501-2558
O: 605.773.5105 | F: 605.773.2804
dot.sd.gov

TO: South Dakota Department of Transportation

FROM: UAS Committee

DATE: October 23, 2020

SUBJECT: Unmanned Aircraft System (UAS) Procedures

Approval Process

Procurement

- A. Refer to the Guidelines document concerning procuring a UAS.

Contractors

- A. Notification provided to project engineer.
- B. Refer to the Consultant Service Manual.

Purpose of Use

- A. Permitted UAS use includes but is not limited to; aerial photography, photogrammetry, bridge inspection, planning, geotechnical field investigations, Light Detection and Ranging (LiDAR) applications, public outreach, mapping construction sites, asset management, asset inspections, traffic monitoring, incident management, disaster response, and training exercise.
- B. The purpose of each flight will be documented in the pilot log.

Documentation and Data Retention

- A. All data derived from internal UAS use, contracted UAS service providers or for the Department use through projects will be maintained according to the Department policies.
- B. All raw data may be stored on the SDDOT state server including data, images, video, and metadata captured.
- C. All processed data may be stored on SDDOT servers.

Roles and Responsibilities

Division Director

- Provide approval or disapproval for all UAS purchase requests in their respective division after review by the UAS Committee.
- Provide approval of UAS Procedures.

UAS Committee

- Support all agency owned UAS.
- Annually review and update the UAS Procedures.
- Review submitted UAS Forms and provide a recommended action.

- Facilitate training as needed.
- Maintain a list of licensed and trained pilots.
- Maintain a list of UAS Examiners.
- Review flight plans for compliance with FAA regulations when requested.
- Maintain a list of department owned UAS equipment.
- Reviews COA requests and the need for waivers.
- Submit new COA request to the FAA for approval
- Annually review COA's which have been approved by the FAA.
- Review the UAS purchase proposals and provide a recommendation on whether to purchase to Division Director or designee

Area Engineer or Program Manager

- Designate an individual(s) to update and maintain UAS equipment

DOT Pilots

Remote Pilot in Command (RPIC) will adhere to the following requirements:

Federal Law

- A. The RPIC will use the UAS in accordance with Title 14 of the Code of Federal Regulations (CFR) Part 107.
- B. The RPIC is responsible for obtaining a Certificate of Waiver when UAS operations will not be in accordance with Part 107 prior to flying the UAS.

STATE LAW

- A. The RPIC will adhere to all state laws including those in Title 50, Chapter 15.

Protection of Privacy

- A. The RPIC will limit operations to the specific purpose of the project and employ reasonable precautions to avoid capturing images of the public except those that are incidental to the project.
- B. The RPIC will complete a thorough review of the flight plan prior to flight to determine if privacy is a concern.

Safety Requirements

- A. All UAS flights require a flight plan, see Steps for Use section.
- B. The UAS maintenance log must be reviewed and accepted by the RPIC prior to any UAS flight.
- C. The flight area will be reviewed using a preflight planning application to ensure flight is not prohibited in the area prior to any UAS flight.
- D. A preflight inspection of the UAS by the RPIC is required prior to takeoff to ensure the UAS is airworthy.
- E. A post flight review by the RPIC is required to document any problems or deviations from the original flight plan. Deviations will also be documented in the pilot's log.
- F. A post flight inspection of the UAS is required to be conducted by the RPIC to document any damage to the UAS or required maintenance needed subsequent to the flight. Any needs should be documented in the maintenance log and relayed to the person designated by the Area Engineer or Program Manager

Training Requirements

- A. UAS operations will be conducted by a trained RPIC as required by FAA and Part 107.
- B. The RPIC will maintain a Remote Pilot Certificate from the FAA.
- C. The RPIC will register with the UAS Committee.
- D. Prior to operating any UAS for Department business, the RPIC must conduct a minimum of two hours of flight time training in an UAS training area to develop UAS proficiency for each model of aircraft that will be flown.
 - a. A licensed and trained UAS pilot will identify UAS training areas where training and proficiency checks can be accomplished in a safe manner.
- E. The RPIC is required to complete a proficiency check with a UAS Examiner prior to their first flight outside a training area.
- F. The RPIC will undergo a pilot proficiency check consisting of aeronautical knowledge areas, areas of operations and tasks required for safe operation every 24 months for each UAS model to operated.

Accident Reporting

All accidents involving UAS that result in any injury or property damage shall be reported to the RPIC's supervisor.

All accidents involving UAS that result in serious injury, loss of consciousness, or property damage of at least \$500 must be reported by the RPIC to the FAA as required in FAA Part 107 regulations.

All accidents involving UAS that meet any of the following criteria must be reported by the RPIC to the NTSB as required in Title 49 Part 830.5:

- A. Accidents resulting in serious injury or death.
- B. The aircraft has a maximum gross takeoff weight of 300 pounds or greater and sustains substantial damage.
- C. Flight control system malfunction or failure: For an unmanned aircraft, a true "fly-away" would qualify. A lost link that behaves as expected does not qualify.
- D. Inability of any required flight crewmember to perform normal flight duties as a result of injury or illness. Examples of required flight crewmembers include the pilot, remote pilot; or visual observer if required by regulation. This does not include an optional payload operator.
- E. Inflight fire, which is expected to be generally associated with batteries.
- F. Aircraft collision in flight.
- G. More than \$25,000 in damage to objects other than the aircraft.
- H. Release of all or a portion of a propeller blade from an aircraft, excluding release caused solely by ground contact.

It is the RPIC's responsibility to understand and comply with all FAA and NTSB reporting requirements. All accidents reported to the FAA or NTSB shall also be reported to the UAS Committee and the Office of Aeronautics as soon as practical.

UAS Equipment

- A. All UA will be registered with the FAA and display the appropriate markings as required.
- B. All UAS equipment will require an identification number.
- C. Equipment malfunctions will be brought to the attention of the individual designated by the Area Engineer or Program Manager and documented in the maintenance log.

UAS Maintenance

- A. All UAS equipment will be properly maintained according to the manufacture's recommendations and will undergo a preflight and post flight inspection along with an annual inspection.
- B. All maintenance and annual inspections will be documented in the maintenance log for the each individual UAS equipment.
- C. The UAS maintenance log will document at a minimum the following information: UAS identification number, date, inspection performed, maintenance performed, damage or malfunctions incurred during operation, repairs made and additional notes or comments.

Steps for Use

The RPIC will:

- Establish a flight plan that includes at a minimum:
 - Airspace review
 - Conduct weather assessment
 - Area to be flown
 - Limitations
 - Obstacle clearance
 - Purpose of flight
 - Anticipated date and time of flight
 - Expected duration of flight
 - Communication plan
 - Emergency/contingency procedures
 - Anticipated UAS project crew members
- Check out UAS equipment from Area Engineer or Program Manager or their designee
- Complete preflight checklist
- Complete post flight checklist after flight.
- Transfer all data, images, video, and metadata captured on to a SDDOT state server and use SDDOT naming conventions as required
- Return UAS equipment to Area Engineer or Program Manager or designee and communicate any UAS malfunctions, damage incurred, and maintenance and/or repairs needed.

General Flight Requirements

UAS operations shall be in accordance with Part 107 which includes these and other requirements:

- A. Visual line-of-sight (VLOS): the UAS must remain in VLOS of the RPIC or visual observer.
- B. Location: UAS may not operate over any persons not directly participating in the operation, not under a covered structure, and not inside a covered stationary vehicle.
- C. Allowed flight times: flight can be accomplished during daylight or civil twilight (30 minutes before official sunrise to 30 minutes after official sunset, local time) with appropriate anti-collision lighting.

- D. Battery life: flight must be conducted with enough remaining battery to ensure safe landing at the home point or the alternative landing point identified in the flight plan and with enough reserve battery life to ensure safe landing at the alternative site if landing at the home site is not possible.
- E. Weather visibility: the minimum weather visibility distance is three miles from your control station.
- F. Flight altitude: the maximum flight altitude is 400 feet above the ground and higher if the UAS remains within 400 feet of a structure unless otherwise directed by LAANC (Low Altitude Authorization and Notification Capability system) authorization.
- G. Flight speed: the maximum flight speed is 100 mph (87 knots).

Consequences of Misuse

Unauthorized uses can result in legal action by third parties, loss of authorization to operate UAS for the department, and/or discipline up to and including termination.

Appendix E: South Dakota DOT UAS Operational Guidelines

Unmanned Aircraft System (UAS)

Effective Date: 10/23/2020

Purpose

To define the use of Unmanned Aircraft Systems (UAS) for the purpose of conducting South Dakota Department of Transportation (Department) business.

Guidelines

UAS Use

UAS may be used when it provides cost efficiency, improved data quality, or improved personnel safety over an existing method or process. UAS may be used to perform a wide range of Department functions.

Employees are prohibited from using privately owned UAS for Department business.

UAS service providers must use company owned UAS for Department business, unless under written agreement with the Department. Consultants, please refer to the Consultant Service Manual.

All UAS operations will comply with Federal Aviation Administration (FAA) Part 107 regulations involving operations, pilot certification, aircraft registration, waivers/authorizations, and airworthiness standards.

The UAS Remote Pilot in Command (RPIC) has the final authority and responsibility for the operation, safety, and FAA Part 107 regulatory compliance of any UAS operation. Employees or offices that require assistance complying with FAA regulations will consult with the Office of Aeronautics.

Aspects of these guidelines are not to be construed as to restrict the safe, rapid deployment of an agency owned or contracted UAS in response to an emergency or exigent situation to protect life and limb, critical transportation infrastructure or the environment. Emergency use shall be in accordance with FAA requirements for emergencies as noted in FAA requirements.

Operational and Training Requirements

SDDOT employees must register with the UAS Committee as Remote Pilot in Command (RPIC) prior to operating a UAS with the following information:

Name:

FAA Remote Pilot Certificate #:

Proficiency Check Date:

Model(s) of UAS Approved to Fly:

Division and Office:

Prior to operating any UAS for Department business, the RPIC must conduct a minimum of two hours of flight time training in an UAS training area to develop UAS proficiency for each model of aircraft that will be flown. The RPIC must then satisfactorily complete a Proficiency Check with the UAS examiner to demonstrate operational knowledge and proficiency.

Employees must subsequently complete a satisfactory Proficiency Check with the UAS examiner no less than once every 24 calendar months.

Department UAS flights will be tracked following the UAS Procedures.

UAS Procurement

The procurement of a Department owned UAS requires the approval of the appropriate Division Director.

The requesting Division Director or designee will submit to the UAS Committee a detailed explanation and justification for an aircraft, the intended purpose, time, manner and location of use by using the request UAS Form.

Procurement will be in accordance with applicable statutes, rules and Department procurement policies and procedures.

Safety Procedures

Employees operating a UAS will comply with the Department safety manual and FAA safety regulations. Refer to the UAS Procedures.

Protection of Individual Privacy and Personal Information

UAS RPIC will limit operations to the specific purpose of the project and employ reasonable precautions to avoid capturing images of the public except those that are incidental to the project.

Accident Reporting

All accidents involving UAS that result in any injury or property damage shall be reported to the RPIC's supervisor. Accidents meeting the reporting requirements of the FAA and NTSB shall be reported by the RPIC to the respective organization as required in FAA Part 107 and Title 49 Part 830.5. It is the RPIC's responsibility to understand and comply with all FAA and NTSB reporting requirements. All accidents reported to the FAA or NTSB shall also be reported to the UAS Committee and the Office of Aeronautics as soon as practical.

In the case of UAS service providers, notification of any reportable incident should also be made in writing, as soon as practical to their specified contact at the South Dakota DOT.

Definitions:

Certificate of Waiver or Authorization (COA)

An authorization issued by the FAA to grant NAS (National Air Space) access for a specific UAS activity. COAs contain requirements the holder must follow. The FAA issues COAs for both public UAS operations and civil UAS operations.

Flight

Each flight is required to have a flight plan. Refer to the UAS Procedures.

Remote Pilot in Command (RPIC)

A person who holds a pilot certificate with an UAS rating and has the final authority and responsibility for the operation and safety of an UAS operation conducted under part 107.

Project

A project normally has a specific purpose, timeframe and defined location. A project may require multiple flights.

Unmanned Aircraft (UA)

The flying portion of the system, flown by a pilot via a ground control system or autonomously through use of an on-board computer, communication links and any additional equipment that is necessary for the UA to operate safely.

Unmanned Aircraft System (UAS)

The UA and all the associated support items such as equipment, control station, data links, telemetry, communications and navigation equipment necessary to operate the unmanned aircraft.

Visual Observer (VO)

A person who assists the RPIC to see and avoid obstacles.

Appendix F: South Dakota DOT UAS Flight Review



sUAS Flight Review

A satisfactory Small Unmanned Aircraft Systems (sUAS) Flight Review is required prior to operating any sUAS on a Department project. The flight review is intended to ensure basic knowledge, skills, and proficiency are in place to support safe and effective sUAS operations, and to comply with FAA Part 107 regulations. The review includes both a demonstration of knowledge and demonstration of flight proficiency.

An FAA Part 107 Remote Pilot Certificate and a minimum of two hours of flight time are required prior to scheduling a flight review. Additional training and flight time may be needed to develop operational proficiency. A registered sUAS will need to be supplied by the applicant.

Components of the flight review include:

Demonstration of Knowledge

- FAA Remote Pilot Certificate
Able to produce a certificate.
- Aircraft registration and marking
Understands non-hobby registration and marking requirements.
- Firmware and application updates
Understands importance of updating firmware and applications.
- Charging/storing batteries
*Understands the importance of charged batteries and impact of wind in returning home.
Batteries should be stored where they don't make contact with metal objects.
Extreme temperatures impact battery performance.*
- Check weather conditions
How to check local weather using approved weather source.
 - NOAA (1800WXBrief), B4UFly App, Aloft App, AirMap App*Knows weather minimum requirements.*
 - Min. 3 miles visibility, 500' below and 2,000' horizontal from clouds.
- Checking airspace and authorization requirements
*Understands how and where to check uncontrolled vs. controlled airspace.
Identifies when authorizations/waivers are needed.
Demonstrates ability to access and operate the LAANC system.
Is aware of standing stadium flight restrictions in South Dakota.
Knows how to check for Temporary Flight Restrictions (TFRs).*
 - Understands flight prohibited without specific FAA authorization.
- Site plan/flight plan
Reviews site ahead of time and formulates plan for safe and effective flight.
- Part 107 regulations
*Review random selection of Part 107 regulations.
Demonstrates understand and applications of flying at the South Dakota DOT.*
 - Flights over people and vehicles.
 - Deviation from rules to extent necessary to address emergencies.
 - Remote Pilot in Command (RPIC) is responsible for and has final authority.
 - Can't act as RPIC if medical condition interferes with operation of sUAS.

- Commitment to maintaining a strong safety culture
 - Demonstrates intent for:*
 - *Professionalism and making good judgements.*
 - *Complying with Part 107 requirements and DOT procedures and guidelines.*
 - *Maintaining recency requirements every 24 calendar months.*
 - Reporting accidents immediately with supervisor.*
 - Reporting accidents within 10 days to FAA.*
 - *If it meets criteria of serious injury or damage over \$500.*
- Respect privacy
 - Keep flights limited to specific business purpose.*
 - Reasonable precautions with photos of people and property.*

Demonstrations of Flight Proficiency

- Preflight inspection
- Satisfactory setup, launch point, and launch
- Confirmation of sUAS links
- Maintains visual line of sight
- Manages distractions
- Monitor's battery levels
- Division of attention between flying and scanning for traffic
- Able to operate camera during the flight
- Reacting to emergency situations
 - i.e., lost link or visual contact*

Name of Applicant: _____ **Signature of Applicant:** _____

Date of Review: _____ **Model of Aircraft Flown:** _____

This applicant has satisfactorily completed the sUAS Flight Review.

Name of Reviewer: _____ **Signature of Reviewer:** _____

Date of Review: _____

Comments:
