

Contract No. R-040-050

“Onsite Installation of Secure, Remote, Autonomous, Multi-Drone Operations within the ND Renewable Energy Sector”

Submitted by Evolve Analytics, LLC
Principal Investigator: Joshua Reidy

PARTICIPANTS

Sponsor	Cost Share	
Evolve Analytics, LLC (cash)	\$660,828	
Evolve Analytics, LLC (in-kind)	<u>\$242,600</u>	
Subtotal Cash & In-Kind Cost Share		\$ 903,428
North Dakota Industrial Commission	<u>\$500,000</u>	
Total Project Cost		\$1,403,373

Project Schedule – 18 months
Contract Date – August 9, 2019
Start Date – July 1, 2019

Project Deliverables	
Status Report (for July – December)	January 31, 2020 ✓
Status Report (for January – June)	July 31, 2020
Final Report (for July – December & Comprehensive)	January 31, 2021

OBJECTIVE/STATEMENT OF WORK:

This project will help develop Airtonomy, an autonomous, multidrone operations solution that will be installed onsite in a custom drone housing unit. It will be powered by solar energy and operated remotely. The project includes development of both hardware and software.

This technology, which Xcel Energy plans to utilize once it is developed, has the potential to revolutionize the wind industry in terms of: wildlife mortality monitoring and mitigation, routine inspection and maintenance, and safety and security. Utilizing drones and artificial intelligence will reduce the number of manhours required walking in areas that can be dangerous or inaccessible. It has the potential to decrease costs of monitoring significantly. Inspections of turbines can take place when blades aren’t moving due to a lack of wind, thereby reducing scheduled downtime and increasing productivity.

STATUS:

The contract has been executed.

August 2019

An interim status report has been submitted. The report states in part the following achievements toward deliverables:

Development, deployment, and testing of the custom drone housing unit:

- EA has engaged with ComDel, Northern Valley Machine, and the University of North Dakota regarding hardware design. Microsoft is also being consulted regarding use of FarmBeats. This task will be ongoing through Spring 2020.

Development, deployment, and testing of the control software, including the rules based and safety-oriented processes and safeguards:

- Development of control system software is ongoing with progress primary attributed to technical architecture required by the FAA as well as continued development of the control system, in particular the drone-based software and corresponding cloud DevOps environment. Software development will be ongoing through Fall 2020.

FAA safety case and simulation.

- The Microsoft AirSim simulation, which is pivotal for to the FAA Safety Case, is currently under development. The anticipated completion timeline is Fall 2019. A portion of the simulation work will be displayed within the Fargo Microsoft Innovation Center beginning in October.
- Three primary tasks are ongoing. The first is creation of a Technical Architecture in collaboration with corporate partners. This document is in draft format, being reviewed by Xcel Energy, UND-RIAS, and the Northern Plains UAS Test Site. The final version is slated for completion in September 2019. The second task is exploratory work with a corporate partner and Xcel Energy. The objective is to ensure initial system configuration is satisfactory for the FAA Safety Case and Concept of Operations. This work is ongoing with anticipated completion Fall 2019. The last task is determination of required flights of the core Airtonomy solution to be completed on Xcel Energy renewable energy sites. Due to pending winter weather, these flights will need to occur outside of North Dakota as well. This work will be ongoing through Spring 2020

Additional details are available in the full report.

September 2019

An interim status report has been submitted. The report states in part the following achievements toward deliverables:

Report on the FAA safety case and simulation.

- Microsoft AirSim simulation development was presented for review by UND-RIAS and Airtonomy. A draft of simulation work to be displayed within the Fargo Microsoft Innovation Center in October has been created.
- The Northern Plains UAS Test Site recommended a three-step sequence to obtain FAA operational waivers.

Report on the development, deployment, and testing of the custom drone housing unit.

- Conceptual design elements of the housing unit or “nest” were presented to Xcel Energy, Microsoft, and Airtonomy. A corresponding senior design project was initiated with the University of North Dakota.

Additional details are available in the full report.

October 2019

An interim status report has been submitted. The report states in part the following achievements toward deliverables:

Report on the development, deployment, and testing of the custom drone housing unit.

- Adjustments to conceptual design elements of the housing unit or “nest” were made based upon feedback from Xcel Energy, the Northern Plains UAS Test Site, and UND-RIAS. Airtonomy approved the final design and signed an agreement to create a corresponding prototype.

Report on the FAA safety case and simulation.

- Final adjustments were made to Microsoft AirSim simulation development based upon feedback. A draft of simulation work was presented on the Fargo Microsoft Campus at 1 Million Cups.
- The Northern Plains UAS Test Site, Xcel Energy, UND-RIAS, and Airtonomy met to discuss and approve the following:
 - Technical Architecture Three-step sequence to obtain FAA operational waivers
 - Creation of initial Safety Case and Concept of Operations by 12/1/19.
 - Scaled testing of Airtonomy solution.

Additional details are available in the full report.

November 2019

An interim status report has been submitted. The report states in part the following achievements toward deliverables:

Report on the development, deployment, and testing of the custom drone housing unit.

- Northern Valley Machine (NVM) is currently building the Airtonomy housing unit prototype with a delivery ETA of late Q4 2019 to early Q1 2020. Center for Advanced Design (CAD) was contracted to make corresponding modifications to the drone gimbal mount extension.

Report on the FAA safety case and simulation.

- Initial development is now in the hands of UND-RIAS for implementation. Documentation is still being finalized.
- The Northern Plains UAS Test Site, Xcel Energy, UND-RIAS, and Airtonomy are nearing completion of an initial operating waiver for multi-drone, within visual line of sight for submittal to the FAA.

December 2019

An interim status report has been submitted. The report states in part the following achievements toward deliverables:

On behalf of Airtonomy, the Northern Plains UAS Test Site submitted an operating waiver for multi-drone, within visual line of sight to the FAA for testing on an Xcel Energy site with assistance from UND-RIAS.

January 2020

An interim status report has been submitted. The report states in part the following achievements toward deliverables:

Report on the development, deployment, and testing of the custom drone housing unit.

- University of North Dakota students finalized design of a housing unit, which Airtonomy approved.

Report on the FAA safety case and simulation.

- Airtonomy is working with Xcel Energy and Microsoft to expand simulation to cover a broader selection of power assets.

April 2020

An interim status report has been submitted. The report states in part the following achievements toward deliverables:

Report on the development, deployment, and testing of the custom drone housing unit.

- Northern Valley Machine resumed work on their final housing unit with revised specifications based upon information from UND project work and prototype work.

Report on the development, deployment, and testing of the control software, including the rules based and safety-oriented processes and safeguards.

- UND students are working with Microsoft to program FarmBeats units to work with the Airtonomy solution.

Report on the FAA safety case and simulation.

- Airtonomy is working with Xcel Energy and Microsoft to expand simulation to cover a broader selection of power assets.
- The FAA granted the corresponding multi-drone, within visual line of sight operational waiver at Xcel Energy sites.

Report on demonstration to the FAA of the safe deployment of SRA-MDO capabilities to enhance Wildlife Mortality Monitoring and mitigation, Inspection, Maintenance, Safety, and Security aspects of Renewable Energy sites.

- Initial work at Xcel Energy's Foxtail Wind Site was postponed due to COVID-19 related restrictions.

Updated 4/17/2020