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## North Dakota Renewable Energy Program Status Report

Recipient: Evolve Analytics, LLC  
Contract Number: R-040-050  
Report for time period of: 09/01/19 to 09/30/19

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### **Description of Project**

*Please provide a brief description of the project:*

This project will help develop Airtonomy, an autonomous, multi-drone 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. Software components include technician field application improvements, web application, and on-drone modules.

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.

### **Project Tasks**

*Please describe the progress on all project tasks achieved during the reporting period:*

- Selection of site/domain
  - Progress achieved: This task has been accomplished. EA, UND-RIAS, Northern Plains UAS Test Site, and Xcel Energy all agree to a specific 1.75 x 1.75 mile portion of a North Dakota Renewable Energy site.

- Safety case justification functional elements document
  - Progress achieved: 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.
  - **Progress achieved: The Northern Plains UAS Test Site recommended a three-step sequence to obtain FAA operational waivers.**
- Software development
  - Progress achieved: 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.
  - **Progress achieved: Ongoing development**
- Completed set of simulations of chosen scenarios
  - Progress achieved: 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.
  - **Progress achieved: 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.**
- Safety case and CONOPS approval
  - Progress achieved: TBD
- Buildout of corresponding hardware/software solution
  - Progress achieved: 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.
  - **Progress achieved: 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.**
- Integration of solution
  - Progress achieved: TBD
- Flight tests and report

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- Progress achieved: TBD
- Safety case submission
  - Progress achieved: TBD

## Deliverables

*Please describe the progress on project deliverables, as stated in your contract, achieved during the reporting period:*

- Report on the development, deployment, and testing of the custom drone housing unit.
  - Progress achieved: 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.
  - ***Progress achieved: 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.***
- Report on the development, deployment, and testing of the control software, including the rules based and safety-oriented processes and safeguards.
  - Progress achieved: 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.
  - ***Progress achieved: Ongoing development***
- Report on the FAA safety case and simulation.
  - Progress achieved: 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.
  - ***Progress achieved: 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.***
  - Progress achieved: 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.

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- ***Progress achieved: The Northern Plains UAS Test Site recommended a three-step sequence to obtain FAA operational waivers.***
- 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.
  - Progress achieved: TBD
- Report on the obtainment of a permanent FAA waiver for SRA-MDO installation with a given Renewable Energy domain.
  - Progress achieved: TBD
- Report on the commercialization of the SRA-MDO solution, installed on renewable energy sites along with any growth in market share.
  - Progress achieved: TBD
- Report on benefits for North Dakota, such as estimated income potential and jobs created.
  - Progress achieved: TBD
- Report on a cost comparison of traditional methods for monitoring at a wind farm vs. the SRA-MDO.
  - Progress achieved: TBD

**Expenditures**

*Please provide a breakdown of expenditures. Include all sources of match. Provide supporting documentation as a separate attachment.*

<b>EXPENDITURES FOR THIS REPORTING PERIOD ONLY</b>				
<b>Project Expense</b>	<b>NDIC</b>	<b>REP Recipient</b>	<b>Other Sponsor</b>	<b>Total</b>
Personnel (4 months)		\$6,950.00		\$6,950.00
Field Equipment				
Travel				
Software Development	\$36,535.50			\$36,535.50
Other Direct Costs				
Custom Drone Housing Unit Prototype Engineering				
Custom Drone Housing Unit Equipment				
<b>Total</b>	<b>\$36,535.50</b>	<b>\$6,950.00</b>		<b>\$43,485.50</b>

<b>CUMULATIVE EXPENDITURES</b>				
<b>Project Expense</b>	<b>NDIC</b>	<b>REP Recipient</b>	<b>Other Sponsor</b>	<b>Total</b>
Personnel (4 months)		\$34,750.00		\$34,750.00
Field Equipment				
Travel				

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Software Development	\$118,815.50	\$155,989.00		\$274,804.50
Other Direct Costs				
Custom Drone Housing Unit Prototype Engineering				
Custom Drone Housing Unit Equipment				
<b>Total</b>	<b>\$118,815.50</b>	<b>\$190,739.00</b>		<b>\$309,554.50</b>