

U.S. DEPARTMENT OF  
**ENERGY**

Office of  
ENERGY EFFICIENCY &  
RENEWABLE ENERGY

# Rotor-mounted Bat Impact Mitigation System Project ID # M18

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(on Behalf of Frontier Wind)



## Frontier Wind

Reinventing Wind Power™



# FY17-FY18 Wind Office Project Organization

“Enabling Wind Energy Options Nationwide”

Technology Development

Atmosphere to Electrons

Offshore Wind

Distributed Wind

Testing Infrastructure

Standards Support and International Engagement

Advanced Components, Reliability, and Manufacturing

Market Acceleration & Deployment

Stakeholder Engagement, Workforce Development, and Human Use Considerations

Environmental Research

Grid Integration

Regulatory and Siting

Analysis and Modeling (cross-cutting)

# Project Overview

## M18: Rotor-Mounted Bat Impact Mitigation System

### Technology Summary:

To develop and test a piezo-electric blade-mounted ultrasonic acoustic bat deterrent suitable to provide ultrasonic coverage across the entire rotor-swept zone of a wind turbine, regardless of blade length.

### Period of Performance:

July 2015 – August 2018 (Project terminated by Awardee)

### Technology Impact:

A commercially available bat deterrent will help enable wind energy development across the United States, particularly in areas where the alternative to bat deterrence requires operators to curtail operations, and therefore lose revenue, during times of high risk to bats.

Current bat deterrent technology does not provide full coverage of the rotor swept zone. This project aims to provide full blade coverage, and therefore greater impact reduction.

### Project Goals:

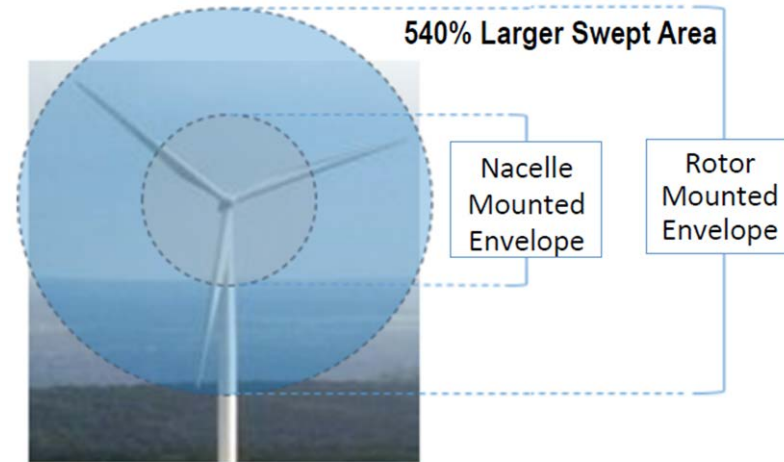
To design, build, and test a blade-mounted deterrent device that can achieve sound pressure levels of 65 dB at 20 meters from the blade over a frequency spectrum of 20–60 kHz

### Partners:

- Pattern Wind Energy, Western Ecosystems, Inc., California Energy Commission, U.S. Forest Service

# Technical Merit and Relevance

- Current solutions to reduce bat fatalities rely on curtailing winding turbines during periods of high bat activity (reducing power generation and revenues), or nacelle/tower mounted deterrents that do not cover the entire rotor-swept area.
- Strike-Free is a full-rotor system to deter bats from flying/foraging near the blades of wind turbines. The system utilizes ultrasound transmitters mounted on turbine blades – while remote monitoring, operating, and communication components are mounted in the hub.
- FY 2015–2016 included system development, fabrication, installation, and preliminary fatality monitoring. FY 2017–2018 included further system improvement and a planned fatality study during the bat migration season.
- Product testing and development has resulted in reliable components exposed to harsh environments and mounting components operating on highly flexible wind turbine blades.
- Existing turbines can be retrofitted with these deterrents to in 2–3 days, deterrents can be ground-mounted during construction in new wind energy projects, or embedded as standard equipment in OEM equipment.



# Approach and Methodology

In FY 2015 - 2016

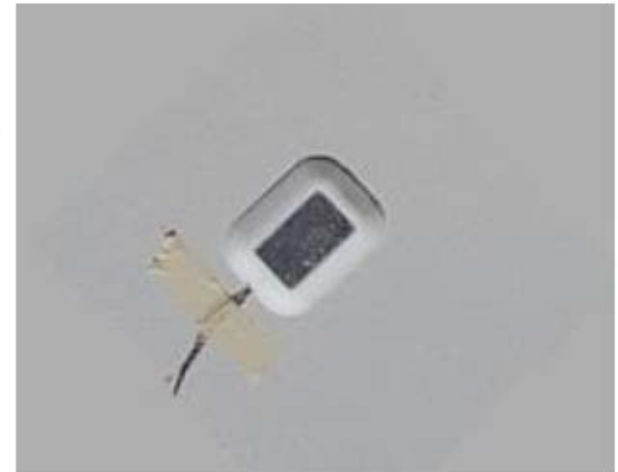
- **Task 1: Site survey, system specification, and test planning**
  - Assess Hatchet Ridge test site historical bat fatality data to plan test protocol, and inform system operational specs to address species at site
  - The initial target was to achieve sound pressure levels of 65 dB at 20 meters from the blade over a frequency spectrum of 20–60 kHz
  - Assess optimal deterrent placement along blade



# Approach and Methodology

In FY 2015 - 2016

- **Task 2: Design, assemble and lab test system**
  - Work with manufacturers to develop transmitters that produce the desired ultrasonic signals at appropriate sound pressure levels
- **Task 3: Installation of Deterrents**
  - Install across 13 (ultimately 12) wind turbines in preparation for field tests

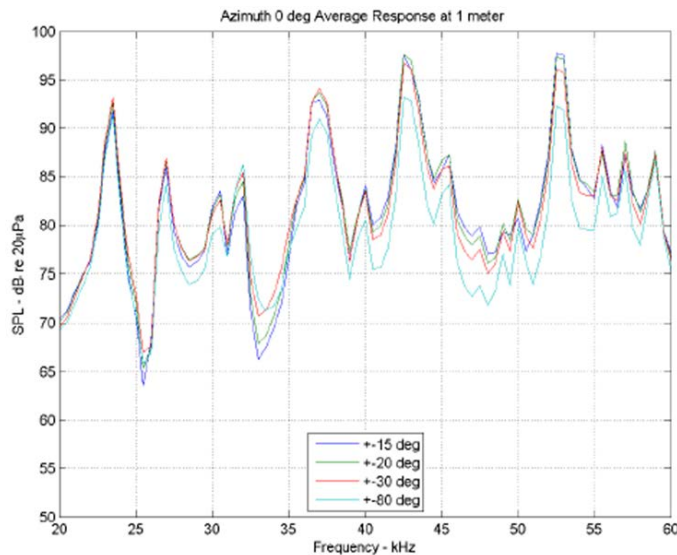


# Approach and Methodology

In FY 2017

- **Task 4: Field Testing and Reporting**

- Validation of acoustic performance of test system using an ultrasonic microphone mounted on the tower, third party assessment of system impact on bat fatalities, and performance reporting.

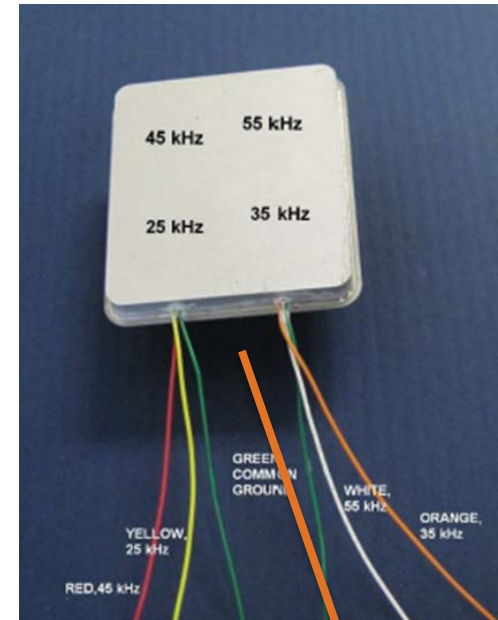


- **Task 5: Benefits Evaluation**

- Review efficacy of system. Make suggestions for improvements for Year 2 of testing.

# Accomplishments and Progress (DOE)

- **Tasks 1-3:**
  - Completed historical fatality data review of Hatchet Ridge, and design of transmitters. To get the desired performance, Frontier settled on a “quad-well” design, which has four transmitters per chamber with peak resonances at 25 kHz, 35 kHz, 45 kHz, and 55 kHz
  - Completed Installation of deterrents
  - Setback: during initial testing the originally-designed power-supplies caused system failures when using power from an operating turbine due to inadequately conditioned power into the units
  - Frontier worked with manufacturer to address, however, at the conclusion of the first field season (Task 4) found that the power-supplies still failed in most cases





# Accomplishments and Progress (DOE & CEC)

- **Task 4: Field Testing (validation of signal & fatality monitoring)**

- Acoustic performance objective: 80% coverage of the frequency spectrum by achieving 65 dB at 10 m.
- Measurements found performance exceeded the requirement of 65 dB at 10m.

Microphone Array



- **Upon completion of data collection (Oct. 13, 2016), Frontier found that nearly all systems experienced another power-supply failure, and that the data they were able to collect was not sufficient for robust statistical analysis**
- **Planned follow-up fatality monitoring in fall 2017**

# Remainder of FY17 – FY18 (CEC)

## Task 5: Evaluation

- For the remainder of 2017 Frontier Wind worked with the power supply vendor to develop a unit that could meet their needs
- Ultimately, they developed a power supply that could withstand the “dirty” power coming from the turbine nacelle
- Tested power supplies at Hatchet Ridge and no issues found after over 5 months of testing
- **However, A working system could not be completed in time for the 2017 field season, so the team decided to push to fall 2018**



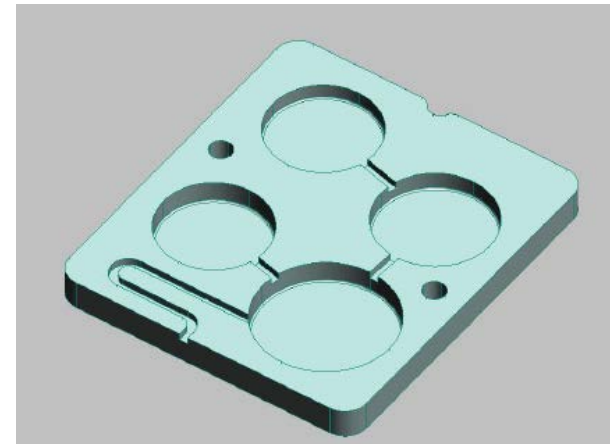
# Remainder of FY17 – FY18

Frontier also continued to iterate on the transmitter design.

- They removed and examined the condition of transmitters that had been installed on the blades for months.
- Finding water damage, went back to the designer to develop a design that kept water from entering the transmitter

Despite the improved power-supply and improvements to the transmitter designs, progress on project reached a standstill. The 2018 California Carr wildfire and other delays prevented final installation and testing

- Frontier Wind could not continue financially, despite having a viable product for testing, and shuttered its business



# Communication, Coordination, and Commercialization

- December 2, 2015, National Wind Coordinating Collaborative Webinar titled: “Developing Technologies for Bat Detection, and Deterrence at Wind Facilities”. Presented by Erick Rickards, Engineering Manager – Frontier Wind titled “Rotor-mounted, Ultrasonic Bat Impact Mitigation System”.
- [https://www.nationalwind.org/wp-content/uploads/2013/05/3\\_NWCC-Webinar\\_Rickards\\_Frontier.pdf](https://www.nationalwind.org/wp-content/uploads/2013/05/3_NWCC-Webinar_Rickards_Frontier.pdf)
- Nov 29, 2016, Wind Wildlife Research Meeting XI, Broomfield, CO – Poster Presentation - Rotor-mounted Bat Impact Deterrence System – Myron Miller, Frontier Wind
- <http://programme.exordo.com/wworm2016/delegates/presentation/103/>