

# Ultrasonic Bat Deterrent Technology

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# Characteristics of GE Ultrasonic Device

## Key Criteria

- Overcome limitations of previous devices
- Broadband ultrasonic emission
- Wide directivity field
- Compact; easily mountable on turbine system
- Less expensive than curtailment solutions
- Robust and easy maintenance
- Compatible with non-GE turbines

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***High speed air jet device provides wide frequency range, broad coverage, and reliability***

- 10x more airspace volume covered for each deterrent device compared to typical transducer based systems
- No electronics exposed to environment
- Simple hardware mechanisms with easy operations and maintenance
- Proper deterrent operation easily verified with standard instrumentation
- No increase to far-field audible noise

# Prior Field Testing Experience



Forward nacelle mounted emitters

Rear nacelle mounted emitters

Tower mounted emitters

Year	Nacelle Emitters	Tower Emitters	Effectiveness
2013	4	0	24.9% (1.75-42.1: 90% CI)
2014	2	2	29.3% (14.7-43.8: 90% CI)
2015	0	4	TBD

# DOE Project Goals

- 1) Develop causal bat behavioral characteristics to understand:
  - How bats respond to various ultrasonic stimuli
  - Deterrent effectiveness on different species and in different bat environments (i.e. foraging, near turbines)
  - How bats interact with operating wind turbines with and without the deterrent operating using video imaging and 3D flight mapping
- 2) Redesign the GE deterrent system based on new behavioral and technology learnings and test the efficacy in a operating wind farm

*Designed by Industry Leading Turbine Manufacturer  
Tested at Major US Wind Farm  
Evaluated by World Class Biologists and Statistician*

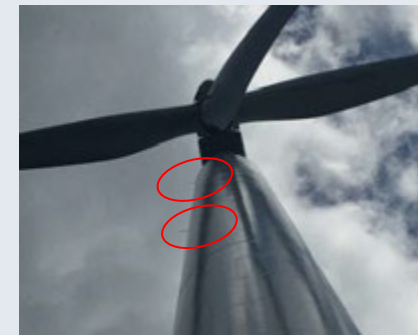
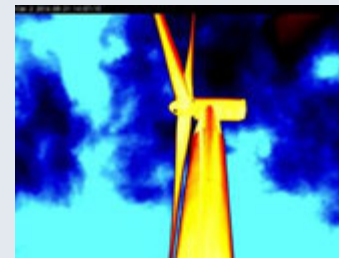


*Flight Room Behavioral Testing to Document Response to Ultrasonic Signals*



*Ground Based Testing for Demonstration of Redesigned Deterrent*

*3D Flight Mapping of Bat Motion Around Turbine*



*Field Testing of Redesigned Deterrent Installed in Operating Wind Farm*