

Wind Turbine Radar Interference Mitigation (WTRIM) Working Group

Program Update Brief



15 April 2015

**Presented by
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Agenda

- Welcome/Introductions
- Program and Project Updates
 - Interagency Field Test & Evaluation (IFT&E) Program Status
 - Wind Turbine Radar Interference Mitigation (WTRIM) Working Group (WG) Follow-on / Interagency MOU Way Forward
 - Pilot Mitigation Project (PMP) Initiative
- Industry Feedback
- IFT&E Summary and Wind-Radar Mitigation R&D
- Questions and Comments

Interagency Field Test and Evaluation (IFT&E) Program Overview

- *Purpose of the IFT&E Program:*

Supported by directives from Congress, the Administration established the IFT&E Program to investigate and address the concerns of growing interference of wind turbines on our nation's air surveillance radars.



- *IFT&E Program Goals:*

- Characterize the impact of wind turbines on existing Program-of-Record (POR) air surveillance radars.
- Assess near-term mitigation capabilities proposed by industry.
- Collect data and increase technical understanding of interference issues to advance development of long-term mitigation strategies.

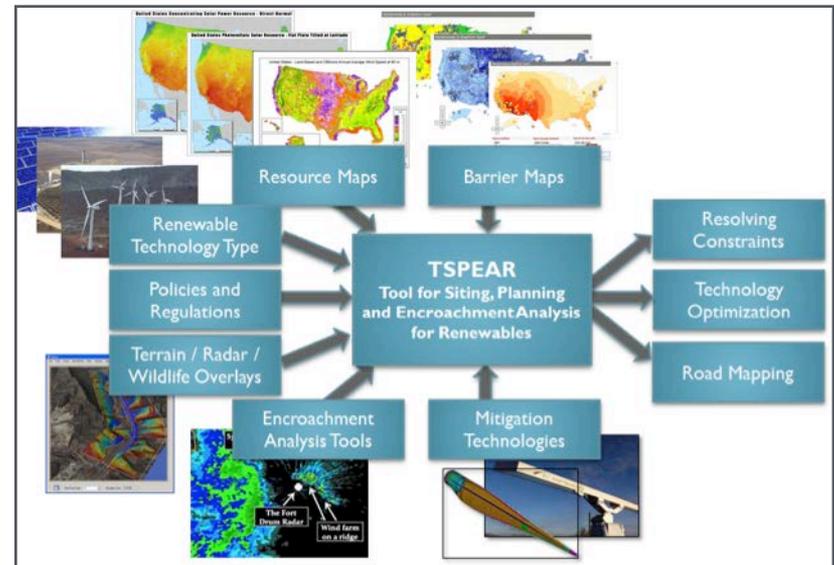
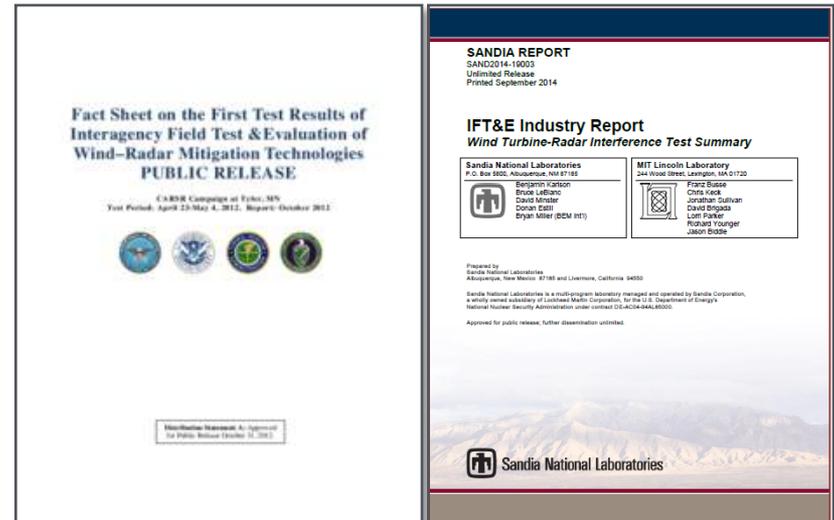
IFT&E Program Updates

- *Conclusion:*

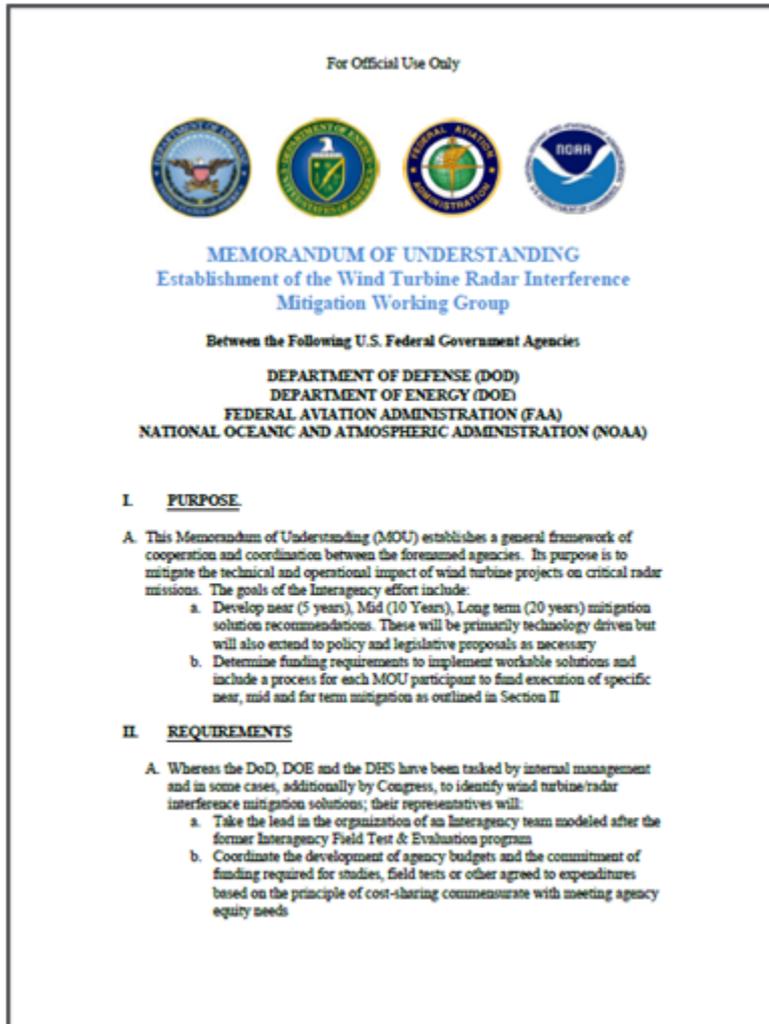
- 3 flight campaigns testing 3 National Airspace System (NAS) radars and 8 mitigation technologies

- Publicly released items: Industry Report and 3 IFT&E Field Test Public Fact Sheets

- Project Siting Initiative (SilverSphere™/TSPEAR Framework)



IFT&E Program Transition to WTRIM WG



- *Purpose of the Wind Turbine Radar Interference Mitigation (WTRIM) Working Group (WG):*
 - The WG’s purpose is to mitigate the technical and operational impact of wind turbine projects on critical radar missions.
 - The interagency Memorandum of Understanding (MOU) establishes a general framework of cooperation and coordination between DOD, DOE, FAA, and NOAA, with DHS as an observer.
 - The WTRIM is a logical follow-on to the IFT&E Program broadening it’s responsibilities.
- *WTRIM WG Goals:*
 - Develop near (5 years), mid (10 years), long-term (20 years) mitigation solution recommendations. These will be primarily technology driven but will also extend to policy and legislative proposals, as necessary.
 - Determine funding requirements to implement workable solutions.

WTRIM WG Priorities

- *Improving Interagency Coordination & Planning*

E.g., capturing all key existing wind turbine radar interference work in the WG's online database



- *Enhancing Modeling & Simulation Capabilities*



Developing, assessing, and validating a suite of potential tools that will improve radar impact assessments and potential mitigation solutions for proposed wind projects considered problematic

- *Rapidly Deploying Near-Term Mitigation Solutions*

➤ Pilot Mitigation Project (PMP) Initiative

- *Medium to Long-Term Research & Development (R&D) to enable wind-radar co-existence*

Expected R&D focus areas:
Infill radars, phased array radars, algorithms, concurrent beam processing, radar data fusion, etc.



Pilot Mitigation Project (PMP) Initiative

- The Department of Defense (DOD) is implementing an initiative that leverages potential mitigation solutions identified as a result of the IFT&E Program and WTRIM WG efforts.
- Considers new wind projects seeking approval through the Federal Aviation Administration's (FAA's) Obstruction Evaluation/Airport Airspace Analysis (OE/AAA) Review process.
- Focus is on solutions in which Gov't can partner w/Industry.



Photos Courtesy of BEM Int'l, LLC

PMP objectives in partnering with industry:

- Protect the quality of DOD mission capabilities that existed prior to the proposed wind turbine project.
- Reduce the time required to implement mitigation solutions.
- Minimize the wind turbine project impact and mitigation cost to government.
- Support renewable energy goals, while managing the risk to stakeholders.

Pilot Mitigation Project Initiative Wind Industry Proposal Approach

- Applies to new wind energy projects identified during:
 - Initial planning activities; mitigation terms negotiated via DOD's Siting Clearinghouse and Mitigation Response Teams.
 - Post-submission determination via the FAA's OE/AAA Review process; mitigation terms negotiated via the DOD/DHS Long-Range Radar/Joint Program Office.

Impacted Agency

- Determines need for mitigation and informs wind developer of their eligibility to participate in a PMP.
- Provides a list of approved mitigation capabilities potentially acceptable for deployment.

Wind Developer

- Collaborates with the mitigation system vendor of their choice to create a developer-funded mitigation plan.
- Proposes plan to the impacted agency.

Proposals must include short and long-term performance studies



Wind Turbine Impacts

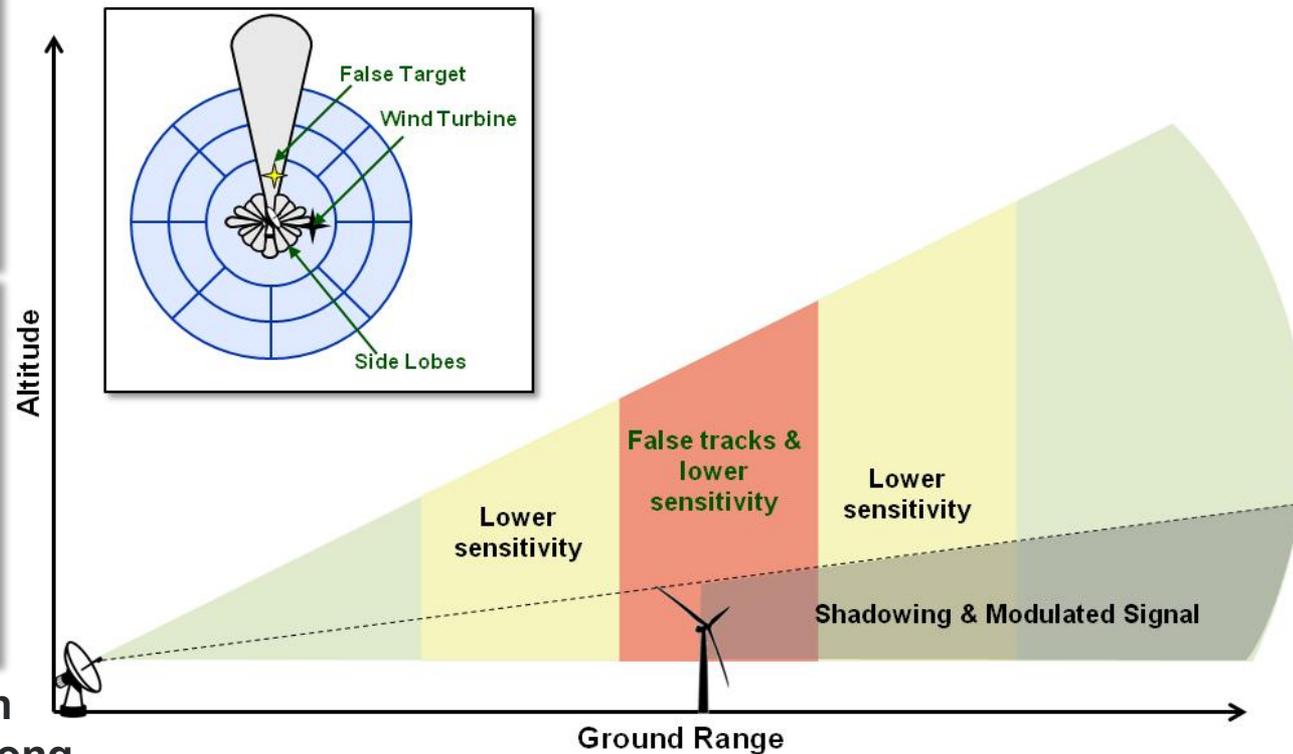
Turbines are growing in size and number



- Decreased Sensitivity (P_D)
- False Targets (P_{FA})
- Corrupted Track Quality

Concern for:

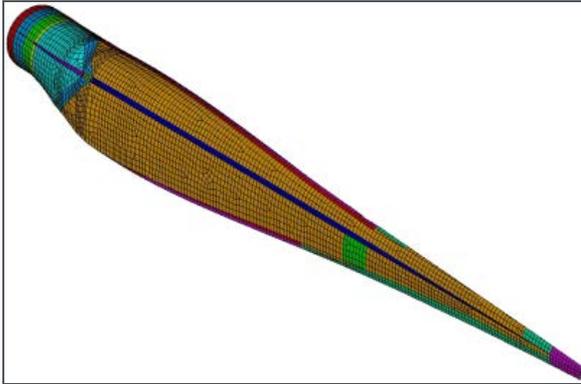
- Flight Safety
- Homeland Air Security



- Tip speeds over 225 mph
- Blades more than 50 m long
- 30 – 40 dBsm
- Wind farms with 100s of turbines

Industry Proposed Mitigation Options

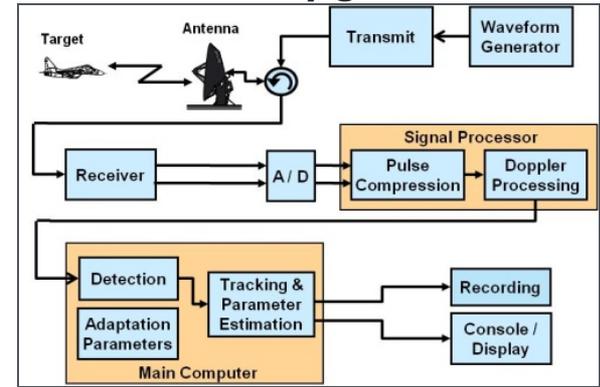
Reduced Signal Turbines



Replacement Radar



Radar Upgrades



Wind Farm Siting



Augmentation Radar

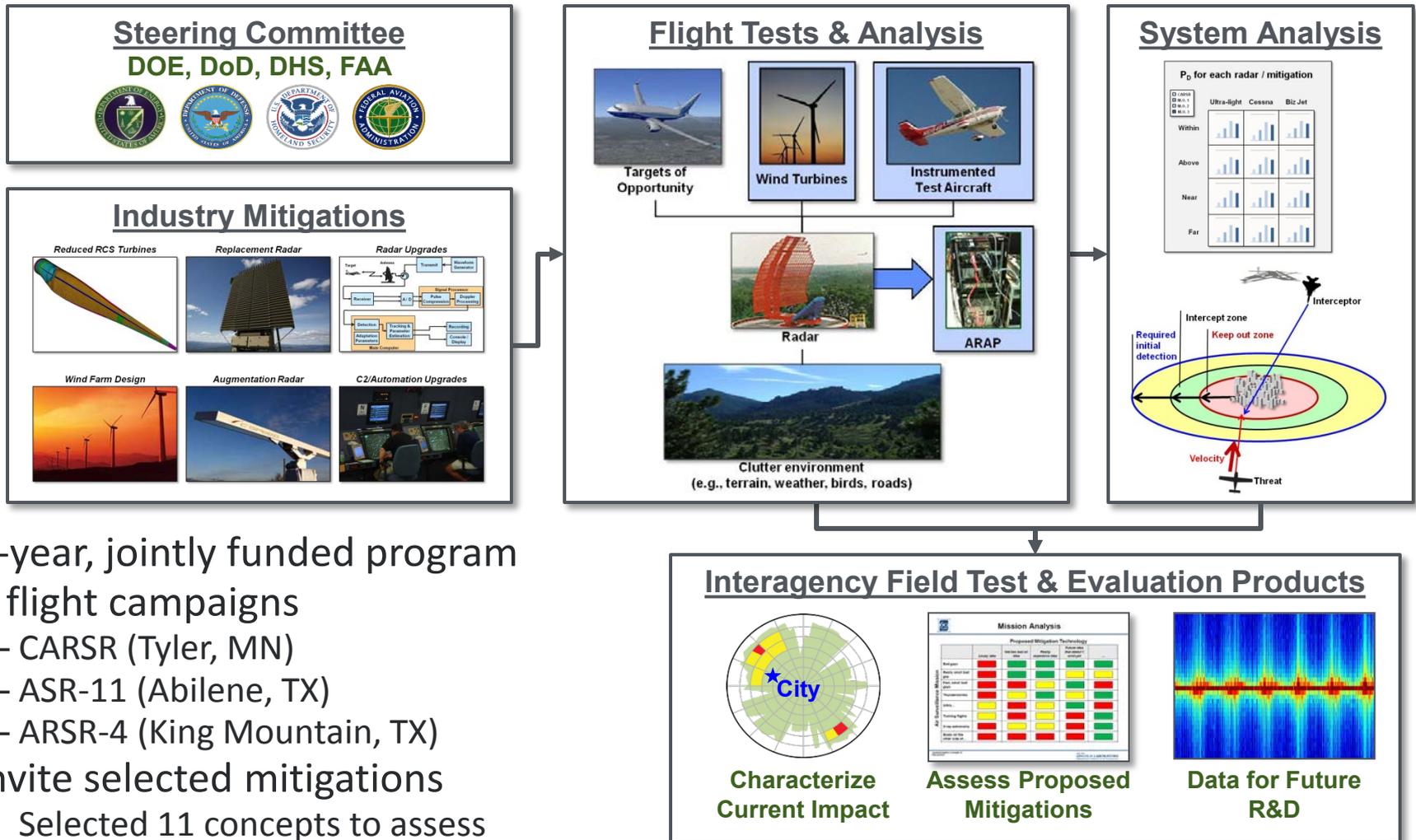


C2/Automation Upgrades



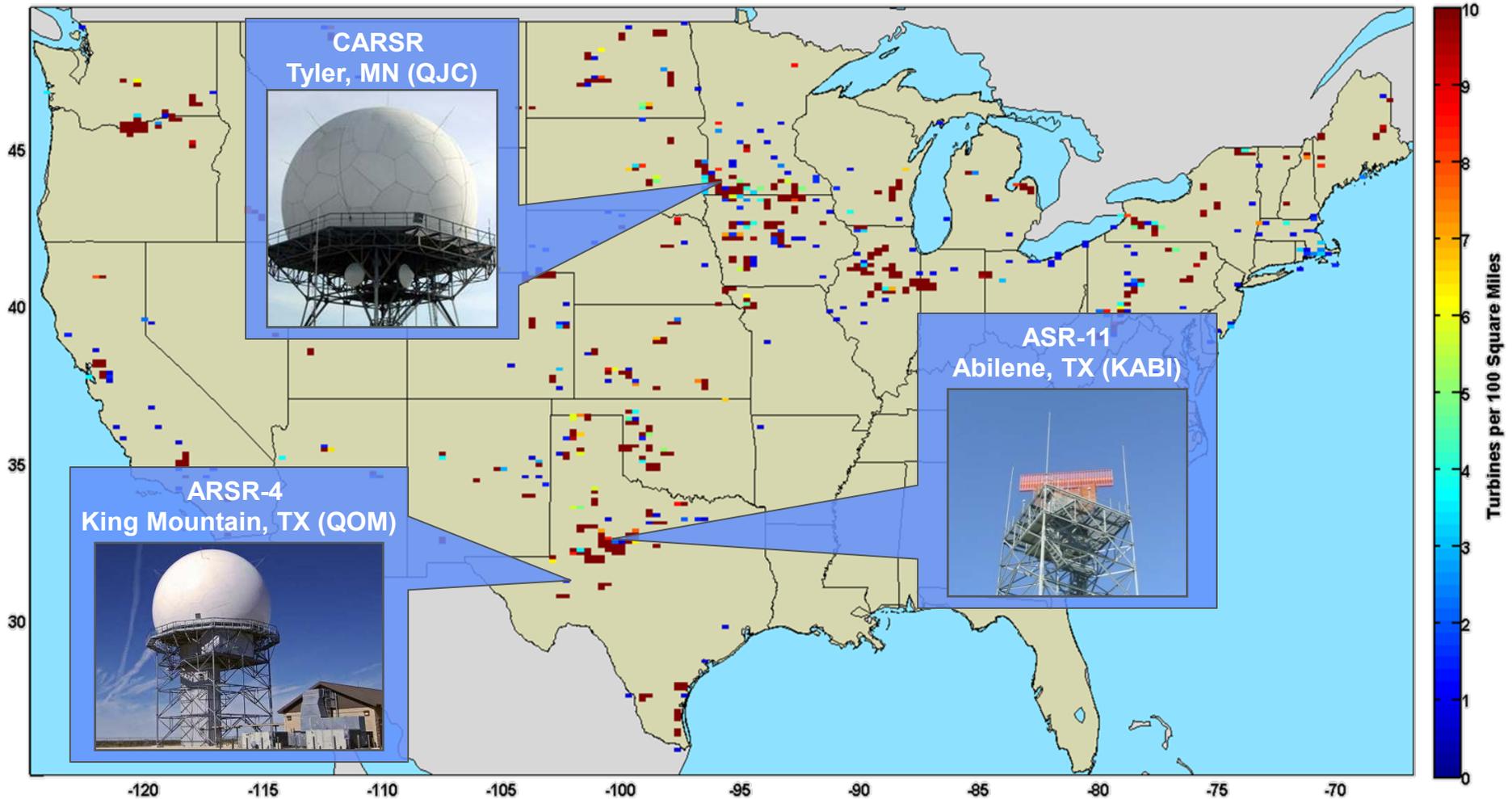
Interagency Field Test & Evaluation

Evaluate wind turbine impact and industry mitigations

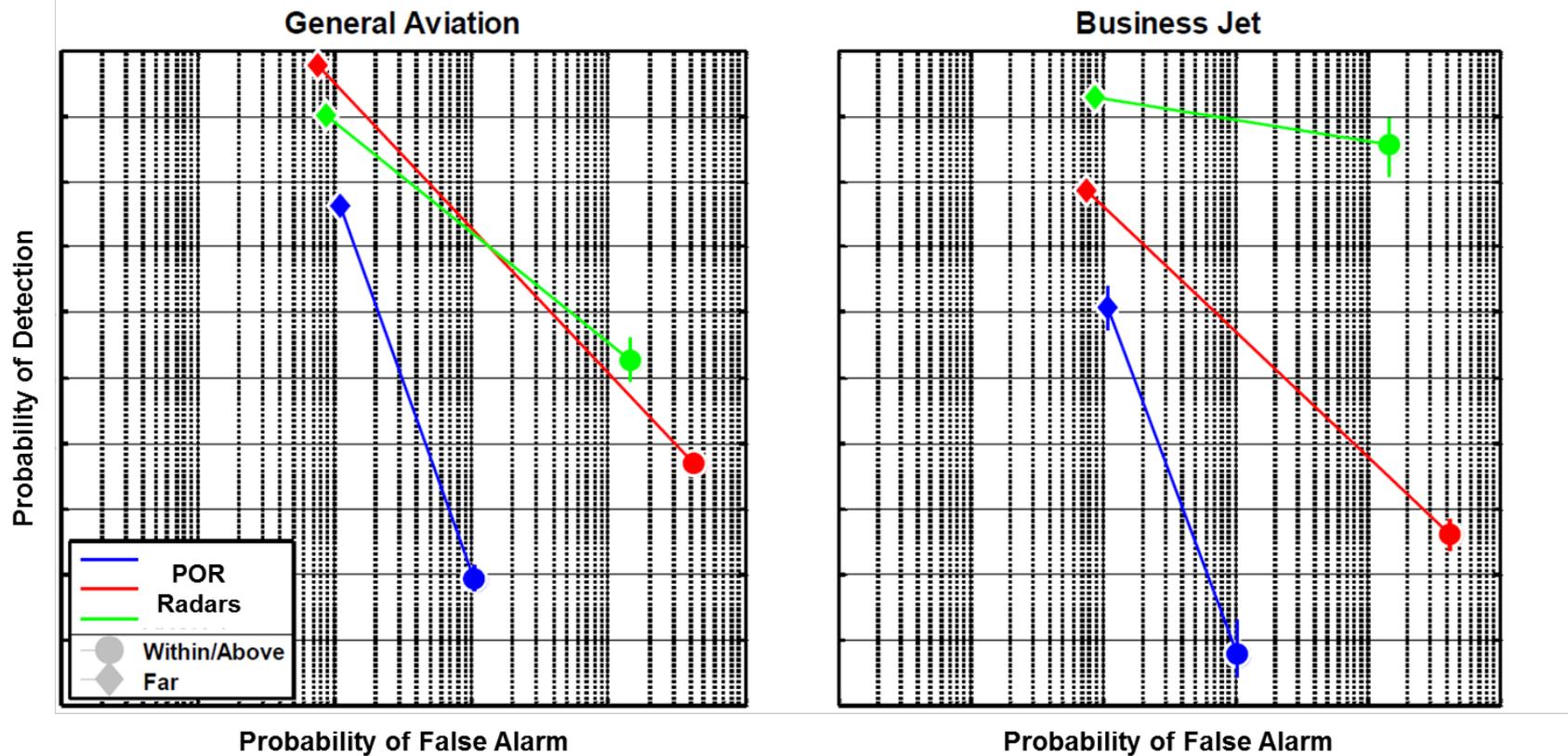


- 2-year, jointly funded program
- 3 flight campaigns
 - CARSR (Tyler, MN)
 - ASR-11 (Abilene, TX)
 - ARSR-4 (King Mountain, TX)
- Invite selected mitigations
 - Selected 11 concepts to assess
- System analysis of mission impact

IFT&E Flight Campaigns



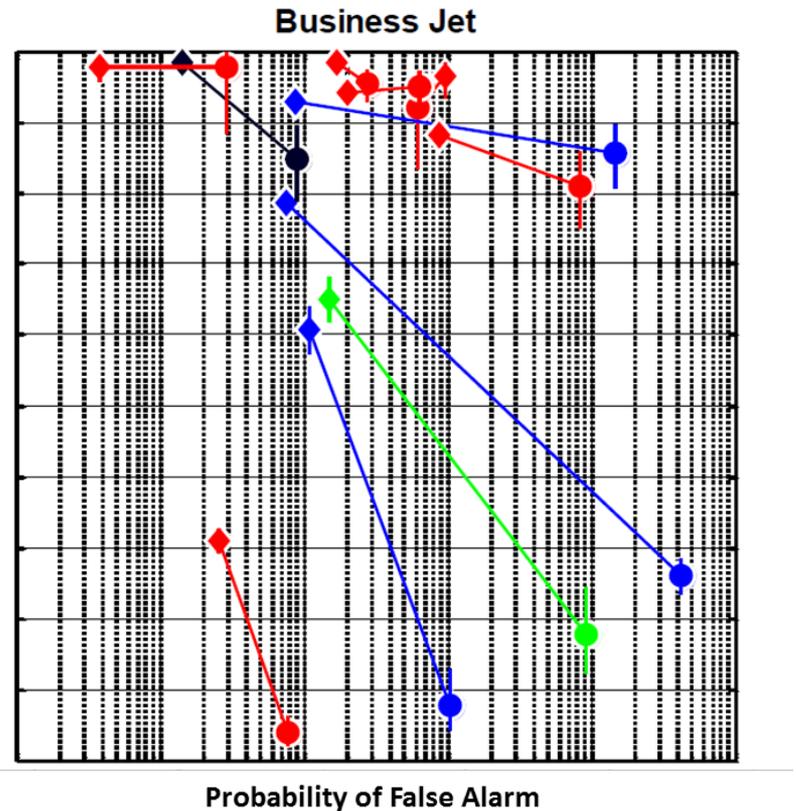
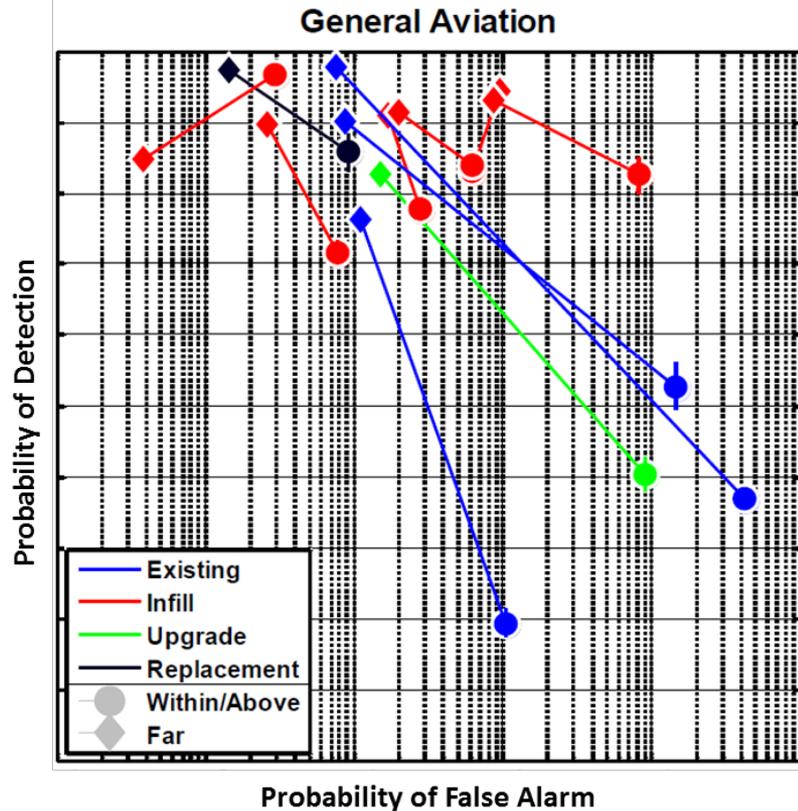
Performance of Existing Radars



Existing primary surveillance radar performance significantly impacted in regions near and above operating wind turbines

SOURCE: IFT&E Industry Report: Wind Turbine – Radar Interference Test Summary, SAND2014-19003, Sep 2014
<http://energy.gov/eere/wind/downloads/interagency-field-test-evaluation-wind-turbine-radar-interference-mitigation>

Performance of Existing Radars and Tested Mitigations

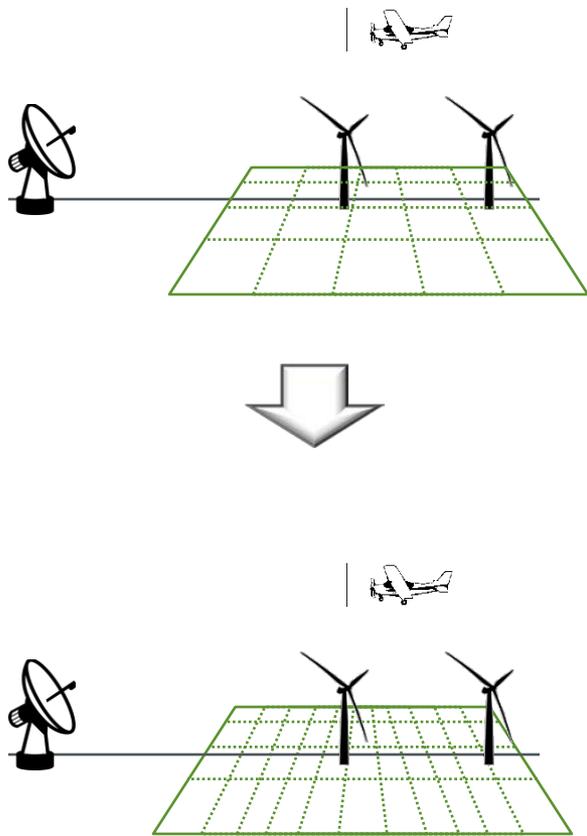


All systems tested were impacted by wind turbines; however, many of the mitigation systems were significantly less impacted than existing radars

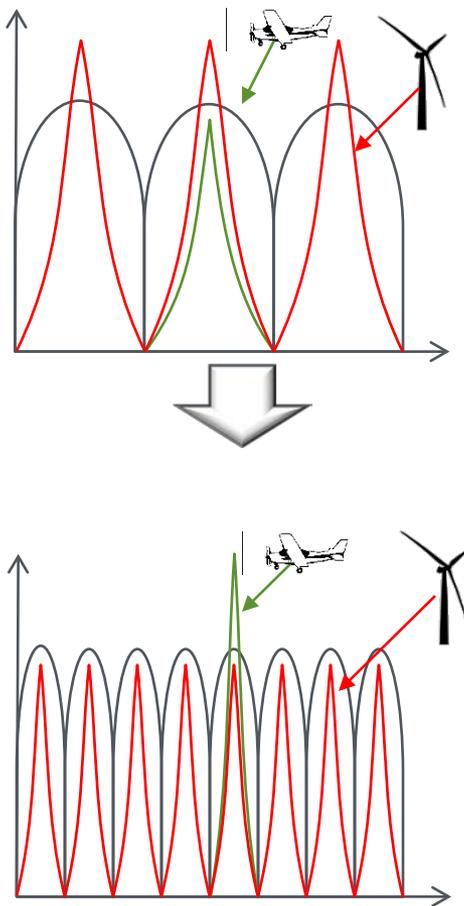
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Radar Approaches to Improving Detection

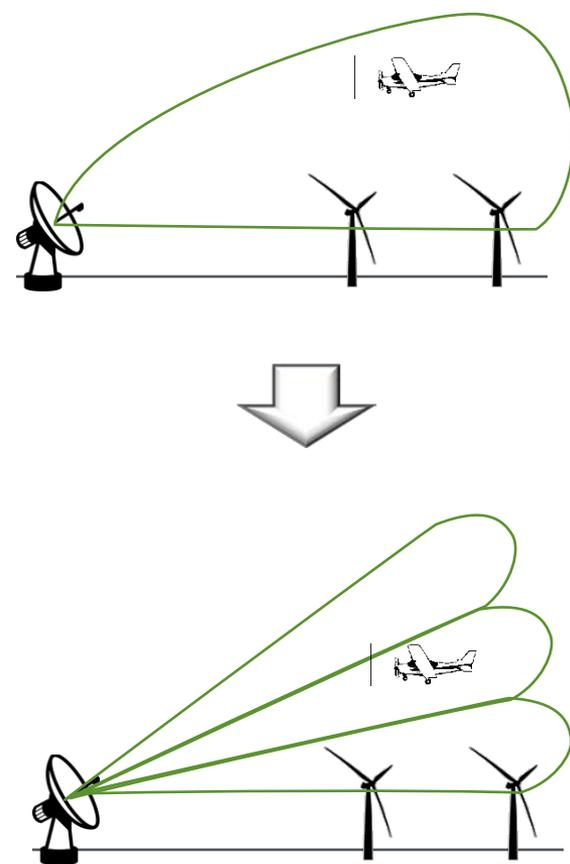
Improve Range Resolution



Improve Doppler Resolution

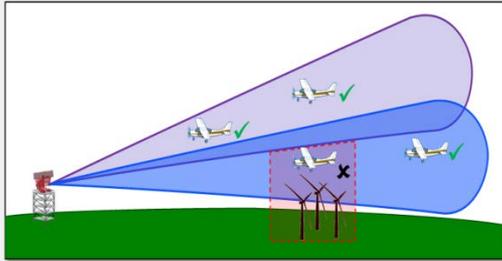


Improve Altitude Resolution



Interference Mitigation R&D Efforts

Existing Radar Algorithm Upgrades



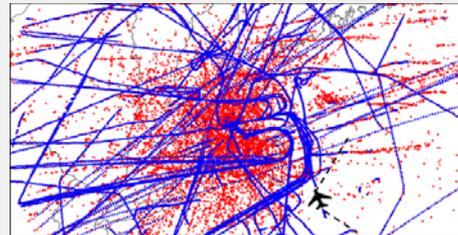
Existing POR Radar

Increased Range Resolution (x5)



- Multi-beam turbine nulling
- Increased range resolution

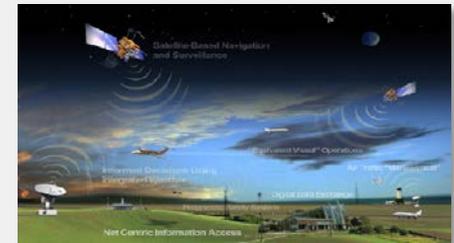
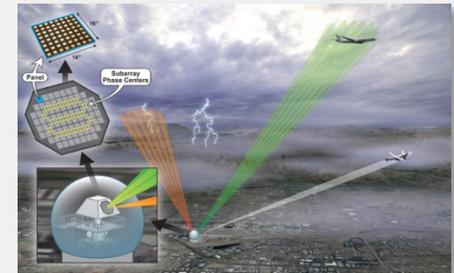
C2/Automation Systems



■ Sensor reports ■ Tracker output

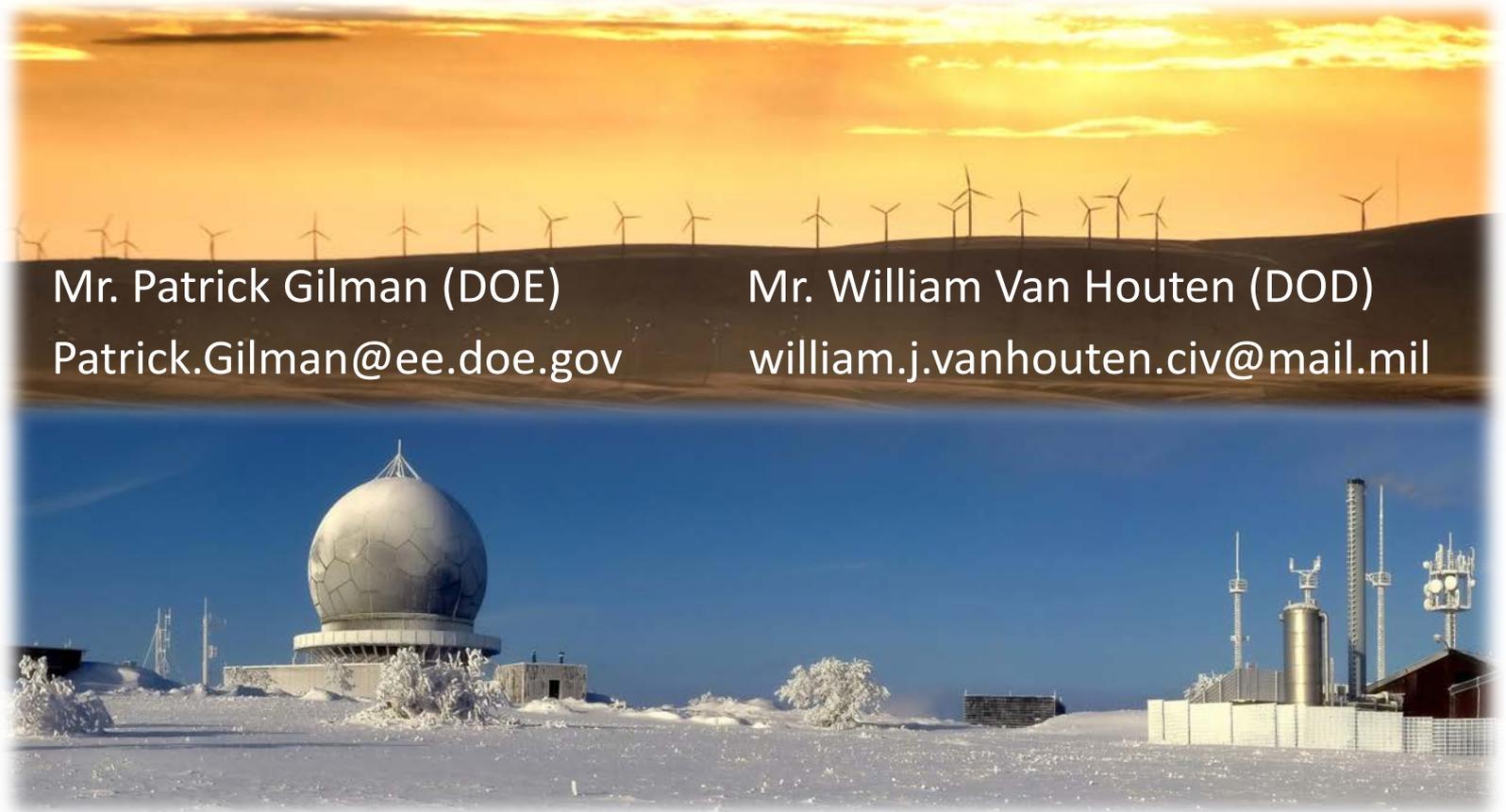
- Radar network tuning
- Advanced sensor fusion

Future Systems



- Mitigation requirements for next-gen surveillance

Points of Contact



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Thank You