Interagency Field Test & Evaluation
An Introduction

Bryan Miller 13 August 2012
Wind Turbine/Radar Interference Defined

Wind turbines have been proven to interfere with radar operations (Air Traffic Control, Aerospace Surveillance, Air Defense, Weather, etc.). The impairments caused by wind turbines on radar span a range from creating clutter and reducing detection sensitivity to obscuring potential targets (among others). These effects on radar systems can inhibit target detection, generate false targets, interfere with target tracking, and impede critical weather forecasts.

This Interagency Team is Committed to Eliminating Wind Turbine/Radar Interference as a Barrier to Wind Energy Development
Outline

- Background
- Program Overview
- Field Tests
- Conclusions
- Questions
Surveillance Radars Are Key Enablers

Coordination

Intelligence Information Sharing

Customs & Border Protection & CBSA

TSA

US & Can CG

FAA

DHS

DOD & DND

LEA / Police

FAA & NAV CAN

Customs & Border Protection & CBSA

TSA

DOC

FAA

FAA & NAV CAN

Integrated Interagency Data Sharing and Communications

Weather Forecast/Warning Picture

Automated Decision Support / Response Management System

Common Air Surveillance Picture

DOC/NOAA

FBI

CIA

CSIS & RCMP

FAA

TSA

DHS

LEA / Police

FAA & NAV CAN

DOC

NWS

Intelligence Information Sharing

Common Air Surveillance Picture

Integrated Interagency Data Sharing and Communications

Weather Forecast/Warning Picture

Automation Decision Support / Response Management System

Common Air Surveillance Picture

Intelligence Information Sharing

Success = Maximized Interagency Partnership

Surveillance Radars Are Key Enablers
Wind Turbine Trends

Growing in Size…

100 Meter Blades
Now in Development

…Growing in Number

Source: DOE
"20% Wind Energy by 2030: Increasing Wind
Energy’s Contribution to U.S. Electricity Supply"
Wind Energy / Radar Challenges Overlap

Of 214 total radars here, 83 of the sites (or 39%) already had Wind Turbines within Radar Line-of-Sight (RLS)

Information current as of 15 Jul 10
Wind Turbine Impacts

Turbines are growing in size and number

• Tip speeds over 225 mph
• Blades more than 50 m long
• Wind farms with 100s of turbines

Impacts on Radars:
• Decreased Sensitivity ($P_D$)
• False Targets ($P_{FA}$)
• Corrupted Track Quality

Raises Concerns for:
• Flight Safety
• Homeland Air Security
• Weather Operations

What Can We do to Mitigate the Impacts?
Industry Proposed Mitigation Options

- Reduced Signal Turbines
- Replacement Radar
- Radar Upgrades
- Wind Farm Siting
- Augmentation Radar
- C2/Automation Upgrades
Outline

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Formation of IFT&E Program

âœ DOE and DOD co-sponsored a interagency workshop in September 2010; stakeholders identified 26 unique research opportunities

âœ The National Security Staff Sub-Interagency Policy Committee on Air Domain Awareness facilitated interagency funding from DOE, DOD, DHS, and DOT/FAA

âœ Path forward focuses on:
  1. Testing and evaluating mature technologies in the near-term
  2. Gathering data for a mission analysis to guide future investments
The IFT&E Program Team

Enabling Partners
Wind Farm Owners/Developers, Radar Manufacturers, City, County, State, Local, Tribal, and Other Private Industry Stakeholders
Project Strategy

Problems
Requirements

Missions

Requirements

System Analysis
Field Evaluations

Assessment

Environment and Targets

Recommendations
- Identify Risks & Gaps
- Investments & Acquisitions

Technologies

Solutions
Capabilities
Interagency Field Test & Evaluation
Evaluate wind turbine impact and industry mitigations

Steering Committee
DOE, DOD, DHS, DOT/FAA

Industry Mitigations
- Reduced RCS Turbines
- Replacement Radar
- Radar Upgrades
- Wind Farm Design
- Augmentation Radar
- C2/Automation Upgrades

Flight Tests & Analysis
- Targets of Opportunity
- Wind Turbines
- Instrumented Test Aircraft
- Radar
- Clutter environment (e.g., terrain, weather, birds, roads)
- ARAP

System Analysis

- Program Goals
  - Characterize impact of wind turbines on NAS radars
  - Assess mature industry-proposed mitigation technologies
  - Increase understanding for developing future mitigations options; develop a library of data

- Interagency Field Test & Evaluation Products
  - Characterize Current Impact
  - Assess Proposed Mitigations
  - Data for Future R&D

- 2-year, 3 flight campaign, jointly funded program
  - CARSR (MN), ASR-11 (TX), ARSR-4 (TX)
- Invites to selected mitigation technologies
  - Selected 11 of 16 proposed concepts to assess
- System analysis of mission impact
Current IFT&E Scope

Campaign 1: CARSR at Tyler, MN
- C Speed Lightwave
- SRC LSTAR(V)3
- Raytheon Processor Upgrades

Campaign 2: ASR-11 at Abilene, TX
- Terma Scanter 4002
- Aveillant CH-Infill
- BAH clutter cancelling posts
- Raytheon Processor Upgrades

Campaign 3: ARSR-4 at King Mountain, TX
- Qinetiq
- LM TPS-77
- Raytheon X-band Infill
- Sensis Saab Radar Upgrades

Confirmed Participation

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Wind-Radar Assessment 14
IFT&E 8/22/2012
Outline

- Background
- Program Overview
- Field Tests
- Conclusions
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Field Test Overview

Targets of Opportunity
- I&Q RF data
- Primary PLOTs
- Tracks
- Beacon PLOTs

Wind Turbines
- SCADA data

Test Aircraft
- GPS telemetry

Infill Radar Systems

ASR-11 (& Raytheon)
- I&Q RF data
- Primary PLOTs
- Tracks
- Beacon PLOTs

AMOSS (DHS)
- Tracks

STARS (FAA)
- Tracks

C2 Automation Systems

ARAP
QJC Vendor Surveillance Area

Red Box: Assigned Surveillance Area (22 x 22 nmi)

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<th>Wind Turbines</th>
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<tr>
<td>Total</td>
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<td>430</td>
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<tr>
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<td>In Box</td>
<td>459</td>
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CARSR
Plots from CARSR
April 24 @ 2:31:14 PM

Beacon & Reinforced Data

All Plots
Surveillance Area Coverage Success

GPS

Points collected: 450000+
Points in test area: 250000+ ( > 55% )
Abilene, TX (KABI) Area Orientation

Avenger Field
Sweetwater, TX

Dyess AFB, TX

Abilene Regional
Airport, TX

KABI ASR-11
KABI Vendor Surveillance Area

Avenger Field
Sweetwater, TX
## Key KABI Area Wind Farms

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<td>135</td>
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Critical Wind Turbine Data Requested from Wind Farm Owners/Operators

- Facilitating collection of wind farm data
  - Points of contact
  - Static data (for each turbine)
    - Turbine location (latitude, longitude, elevation)
    - Manufacturer, model/type
    - Tower height (AGL) and blade length
    - Materials
  - Dynamic data (for each turbine)
    - Timestamp
    - Yaw
    - Blade pitch
    - Blade speed (RPM)
  - Meteorological tower data during test
    - Wind speed at hub height
    - Wind direction
TBD
Conclusions

Â Wind turbines cause problems for most radars
   ï Several mitigation strategies proposed

Â IFT&E program established to assess alternatives
   ï Field tests to gather high fidelity data

Â First IFT&E flight campaign successfully completed
   ï 140+ flight hours
   ï 4 radar systems with >70+ hours data per radar
   ï 430 wind turbines providing SCADA data
   ï Analysis still being completed

Â Preparing for second test in Abilene, TX (Oct-Nov 12)

Â Third test schedule at King Mountain, TX (Apr-May 12)
Questions?

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