Wind Radar Concerns

• Ongoing activities
  – >3000 MW under risk
    • ~300 MW approved since summer
  – All windy states impacted
• Mitigation under development
  – USAF and manufacturer actions under way
• FAA – 1st agency to contact
• DOD’s large green energy goals
• Integrated process needed
FAA Areas of Concern

United States Obstruction Build Map

Legend:
- Potential Build Region
- Build Region
- Clipped_20mBuffer

Prepared by the 44th Stakeholders Evaluation Squadron (44H-SERS), Hill AFB, Utah
09 February 2007

Source: ESRI Data & Maps CD
Created in ArcGIS using ArcMap
20% Wind Goal

Class 3 or Higher Wind Potential for Conflict
FAA LRR Tool

http://oeaaa.faa.gov/oeaaa
FAA LRR Tool - FAA
FAA LRR Tool - NEXRAD
Other FAA Considerations
Why Worry about EMI/Radar Issues?

• Wind resources and radar missions can overlap
• There are many different missions - know your mission
• Be honest about the impact
• Significant impact can shut down the project
• Address up front and avoid long term problems
  – Energy security is a critical mission,
  – Air superiority is a critical mission
  – Drug Interdiction is a critical mission
  – Balance all missions
Impact During Siting

- Due Diligence Questions Must be Addressed
  - Radar
  - National Security Issues
  - Environmental
  - Cost
- Risk Management is Key
- Do Not Invest in Infrastructure Before Approved
- Location is Important
- Early Communication Critical
  - FAA
  - AF/DHS
  - Risk of Disclosure a Challenge
- Radar Line of Sight is First Filter
- Negotiate Final Turbine Locations – new attitude at FAA
Interference

- If there is visibility, there is interference – interference is a relative term
  - Remember, turbines are big reflectors
  - Yet the Doppler only makes up 20% of the return signal!
  - Turbines are going to show up on the screen if visible to radar!
- Interference is not the issue
- Mission impact and co-existence are the issues
- Does interference impact the mission?
DoD and Wind

U.S. Wind Resource and DoD Ranges and Special Use Airspace

Wind Power Classification:
- 1 (Marginal)
- 2 (Fair)
- 3 (Good)
- 4 (Excellent)
- 5 (Outstanding)
- 6 (Superb)

DoD Ranges
Special Use Airspace
Military Training Route
Carribean (1,000 ft and below)

Sources:
- Special Use Airspace: NASA DOD, 2005
Interagency Cooperation

- Outer Continental Shelf – DoD & DoI MoA 1983, update in progress
- West-wide Energy Corridors PEIS - 2006
**DoD & BLM Wind Energy Protocol Process**

1. **Wind developer** → **BLM Field Office**
   - If DoD equities identified: (BLM FO - 30 days)
   - Field level review: (DoD REC - 45 days + 45 days)

2. **DoD REC**
   - Field level review
   - Initial screening
   - LRR JPO

3. **Air space managers**

4. **BLM Field Office** → **R-o-W Decision**
   - If no DoD equities identified
   - BLM HQ
     - If adverse effect/cannot mitigate: (BLM FO - 15 days)
     - Request for DoD HQ-level review

5. **OSD**
   - DoD HQ-level review: (OSD - 30 days)
   - HQ level review
   - Service HQs

6. **If DoD appeals R-o-W decision** → **IBLA**

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1. This chart only includes the DoD and BLM protocol process, it does not represent the complete BLM right-of-way application process.
Challenges:

- FAA and DOD have different operational assessment criteria
- DOD has several internal agencies, all who have different criteria for operations and allowable impacts
- Software under control of radar manufacturers and wind issues are lower priority than FAA and DOD needs
- No single solution for process or mitigation technologies
- Impacts expected to increase as more turbines are installed
Mitigation

- FAA and/or manufacturers mitigation is often available
- Only DOD, DHS, & FAA experts can determine if mitigation is acceptable
- Examples include, but are not all inclusive
  - Impact studies
  - Farm optimization
    - Refine turbine locations
    - Checkerboard
  - Adjust look angle, use multiple beams selectively
  - Reduce RCA (Radar Cross Section Area) – Stealth the Blades
  - Transponder integration
  - Software optimization
  - Added Hardware
    - Post processors and advanced software
    - Adding transmitters and receivers
Mitigation

• Software improvements being investigated
  – Enhanced clutter mapping
  – Use of RAG Mapping
  – **Concurrent** processing
    • Separation of high and low beams
    • Tie to advanced clutter and geo based information
  – Improved signal processing
  – Improved filtering algorithms
  – Advanced tracking
  – Advanced adaptive Doppler filtering techniques
Examples of Improvements

Track Eligibility - Optimized Comparison - WRA

ASR-11 (GPN-30)  Digitized GPN-20

Source: http://www.nationalwind.org/assets/blog/Lok.pdf
Examples of Improvements

Track Eligibility – ASR-11 Optimization Final Results

Before

Probability of Detection
over WRA = 67.53%

After

Probability of Detection
over WRA = 92.72%

Source:
http://www.nationalwind.org/assets/blog/Lok.pdf
Improvements in Tracking Software

Before
Primary lost, track lost

After
Track was maintained

Radar video as aircraft passes over wind farm

Resulting plot output from ADT
Key issues being addressed:

- RFP for radar signatures at both LRR and ATC frequencies.
- ASR-4 (Airport Surveillance Radar) Assessment in Texas, fall 08
- Technical Expert Peer Meeting (November 07)
  - Key findings; US Stealth capabilities, innovative filtering, phase array systems, gap fillers, test signal generators, layout optimization, improved processing, transponders on turbines with performance data, sensor fusion, integrate optical with radar, integrate two pulse discrimination, etc
- Developing Assessment Guidelines for review
- RFP for Advanced tracking demonstration on existing LRR systems
- Develop Assessment Process
Key issues being addressed:

- Develop Wind-Radar Checklist
- Operations Impact Guidelines
- Expand Mitigation Toolbox
- Provide Outreach
  - Integrate screening tools
  - Educate developers on processes and risks
- Plan FY-08 Case Studies and R&D Elements
- Coordinate with Manufacturers of Stealth Turbines
- Support Field Tests (Mitigation and Stealth Technologies)
- Develop assessment appeals process
Prioritized Technical Meeting Findings

- FAA and/or manufacturers mitigation is often available
- Only radar and operations experts can determine if mitigation is acceptable
- Mitigation examples include, but are not all inclusive
  - Impact studies
  - Farm optimization
    - Refine turbine locations
    - Checkerboard
  - Adjust look angle, use multiple beams selectively
  - Reduce RCA – Stealth the Blades
  - Transponder integration
  - Software optimization
  - Added Hardware
    - Post processors and advanced software
    - Adding transmitters and receivers
Prioritized Mitigations being Investigated

- Software improvements
  - Enhanced clutter mapping
  - Use of RAG (Range Aperture Gate) Mapping
  - Concurrent processing
    - Separation of high and low beams
    - Tie to advanced clutter and geo based information
  - Improved CFAR processing
  - Improved filtering algorithms
  - Advanced tracking
  - Advanced adaptive Doppler filtering techniques
How problems are being addressed:

• Multi-pronged approach; multi-stakeholder involvement
• Collaborative research, case studies, radar evaluations, metrics refinements, tools, mitigation development and information sharing
• Commission independent wind radar baseline tests
• Foster technical solutions
• Reduce encroachment mentality
• Make results public and shared
• Foster mitigation discussions,
  – Toolkit meeting October 2007
  – Technical meeting December 2007
  – Jason report meeting January 2008
  – Next technical meeting being planned
Current Activities

- DOE Wind-Radar
  - Technical Assistance to Agencies & Industry
    - Weakened by recent JPO change in prescreening support
  - Mitigation Case Studies
  - Demonstrations – make results public
  - R&D (Blades, Sensors)
  - Multi-pronged approach; multi-stakeholder involvement
  - Collaborative research, case studies, radar evaluations, metrics refinements, tools, mitigation development and information sharing
  - Commission independent wind radar baseline tests
  - Foster technical solutions
  - Reduce encroachment mentality
  - Make results public and shared
  - Shadowing study underway
  - Scheduling three demonstrations
    - Advanced software on ASR-11
    - Gap filling radar on ASR-11
    - Concurrent Processing
Summary

- Raise awareness for action
- Involve all concerned parties
- There is interference from wind turbines
- Do due diligence early
- Case by Case assessment needed
- Approach all issues openly and fairly
- No and Yes are both acceptable answers
- Understand what brought on “NO”
- Address mitigation
- Communicate well and often
- Strive for Win-Win Solutions
- Research and mitigations needed
- Processes needed
Carpe Ventem

www.windpoweringamerica.gov