SCANTER 4002 Radar
Outstanding mitigation of wind turbine radar interference during test (IFT&E)

THE CHALLENGE
Wind turbines grouped in large wind farms may have a significant effect on air traffic control (ATC) radars and other aviation radars as they are designed to show moving objects like aircraft and filter out anything stationary. The spinning blades of wind turbines may appear on radar screens as false aircraft. The interference (or "clutter") generated by wind turbines may desensitize a radar in the area of a wind farm, causing legitimate targets to disappear. This may affect the deployment of wind farms. Several planned wind farms have been delayed significantly or halted due to objections raised by military or civil aviation authorities.

IFT&E PROGRAM
The US Administration established the Interagency Field Test & Evaluation (IFT&E) program in 2010 in response to the increasing challenges with wind turbine impact on air surveillance radars. IFT&E intended to investigate near term and off-the-shelf solutions to mitigate the impact of wind turbine radar interference.

The IFT&E was sponsored by Dept. of Defense (DOD), Dept. of Energy (DOE), Dept. of Homeland Security (DHS) and Federal Aviation Administration (FAA). Terma was selected to participate in the program. And in October 2012 Terma participated in the second IFT&E flight test with the SCANTER 4002 Wind Farm Compliant Air Surveillance Radar.

TESTING
The test location in Abilene, TX had more than 500 wind turbines within line of sight. With an instrumented range of up to 40 nautical miles, the entire test area was covered with a single SCANTER 4002 radar.

During the test, recorded data from the SCANTER 4002 was provided at the end of each day to the two national laboratories: DOD’s Massachusetts Institute of Technology (MIT LL) and DOE’s Sandia National Laboratories. The laboratories compared the SCANTER 4002 data with actual GPS data from the test program aircraft to evaluate performance and mitigation potential.
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TEST RESULTS
The SCANTER 4002 demonstrated exceptional results during the IFT&E.

Data show that SCANTER 4002 was able to detect and track a variety of aircraft with an unsurpassed track probability of 98% over wind farm and 99% outside wind farm areas while maintaining probability of false alarm rates as low as 10^-7.

Compared to existing air traffic control radars, SCANTER 4002 demonstrated a remarkable resilience to wind farm clutter and was able to resolve targets from wind turbine without increasing the number of false alarms.

Data accuracy was well within specifications of existing air traffic control radars.

SCANTER 4002 RADAR
The SCANTER 4002 is a 2D coherent X-band radar with pulse compression and MTI-processing that is capable of fully mitigating the effects of wind turbines.

The radar belongs to a series of off-the-shelf products and provides mission proven technology based on standardized products at a very attractive price / performance ratio.

SCANTER 4002 is capable of mitigating multiple wind farms. Consequently, in most cases, only one radar is needed to cover a large area. The range of SCANTER 4002 enables it to be co-located with existing air traffic control radars to eliminate slant range integration errors and reduce infrastructure requirements.

SCANTER 4002 RADAR FEATURES

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
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<tbody>
<tr>
<td>WIND TURBINE MITIGATION</td>
<td>SCANTER 4002 is able to fully mitigate the radar interference of wind farms by automatic detection and tracking of aircraft over wind farms with a very high probability of track (&gt; 90%) and extremely low probability of false track (&lt; 10^-7).</td>
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<tr>
<td>RADAR COVERAGE</td>
<td>SCANTER 4002 is the only wind farm radar with a range up to 40 nautical miles and a vertical coverage up to 40,000ft. (dependant on antenna selection)</td>
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<td>INTER-TURBINE VISIBILITY</td>
<td>SCANTER 4002 is the only radar with 360° coverage and inter-turbine visibility. High sensitivity and resolution allow tracking of aircraft between turbines in a wind farm.</td>
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<td>UPDATE RATE</td>
<td>With a standard update rate of 4s (15 RPM) and optional update rates down to 2s, SCANTER 4002 is compliant with aviation requirements.</td>
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<td>RELIABILITY</td>
<td>SCANTER 4002 offers high reliability and low life-cycle cost. The radar includes features like redundant operations for increased reliability.</td>
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<td>DATA OUTPUT</td>
<td>Data output is provided in EUROCONTROL ASTERIX CAT. 034/048 data format for easy integration into existing systems.</td>
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<td>INTEGRATION</td>
<td>With a range of up to 40 nautical miles SCANTER 4002 can be colocated with existing radars to eliminate slant range integration issues.</td>
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<tr>
<td>REFERENCES</td>
<td>SCANTER 4002 is COTS equipment providing mission proven technology. There are currently more than 20 radars of the SCANTER 4000 family of radars in operation worldwide.</td>
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VIDEO:
"Flight test using Terma SCANTER 4002 in Abilene, TX, USA (IFT&E)"