SOLVING THE CHALLENGE OF WIND FARMS AND RADAR

How renewable energy generation and aviation can exist within the same airspace

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The EU has an ambitious climate policy goal to become the first climate neutral continent by 2050. To achieve this the European Commission presented Europe's 2030 climate targets last year. The targets seek to achieve at least 40% of energy use from renewable sources.

The EU needs to build 30GW of wind energy per year by 2030 to help achieve that target. More than 80% of new wind capacity will be built onshore, which will take wind farms closer to the already high-density populated areas and contribute to the already cluttered air environment.

Right: The latest ASR-NG radar ensures safe ATC service

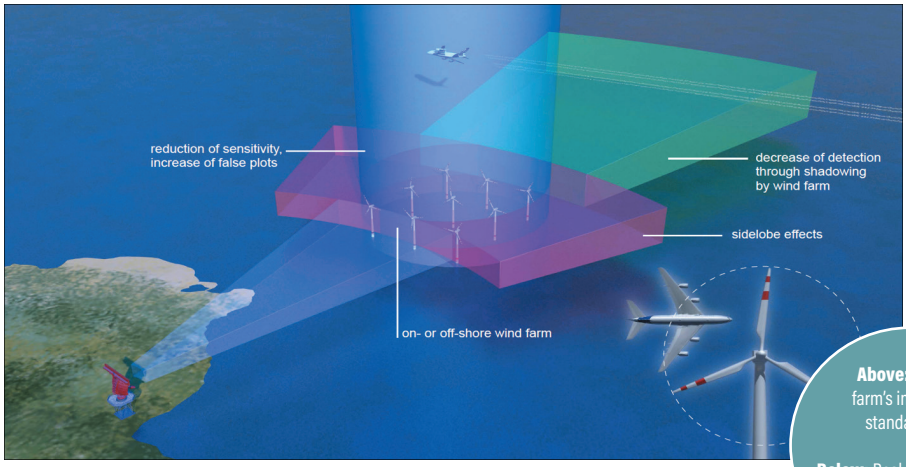
Wind farms interference

The presence of more and considerably larger wind turbines, some of them positioned in the vicinity of airports, will interfere with ATC radars, causing a challenge to delivering safe air operations in increasingly dense wind turbine environments. As a rule of thumb each large wind turbine has a radar cross section (RCS) of 15,000m² (161,500ft²), that of a large airliner, and a radar trials aircraft has an RCS of 2m² (21ft²).

In simple terms the wind turbines dazzle radars due to their very strong radar returns. This challenge will further increase with the introduction of floating wind farms into the previously inaccessibly deep waters, and potential gas / oil cuts will foster the building of huge offshore wind parks. Properly mitigated, this will allow lucrative generating complexes to be approved and national renewable targets to be achieved alongside

"The aviation community must engage positively in the process of developing solutions to potential conflicts of interest between wind energy and aviation operations"

CAP 764 Policy and Guidelines on Wind Turbines – UK Civil Aviation Authority (CAA)



Above: A wind farm's impact on standard ATC

Below: Real world passive radar tracks south of Germany

safe air operations. The situation effects civil and military air traffic control as well as air defence units, which need to provide control services to civil and military air traffic. Some modern ATC radars can differentiate between types of objects and determine the height of an object, known as 3D, where older generation ATC radars are limited to 2D.

Older radars can provide reliable detection but only clear of wind parks. Furthermore, any wind turbines positioned between the radar and a distant target cause a shadowing effect, reducing weather radar performance, affecting radar returns and creating safety issues for aircraft flying at low altitude.

To mitigate the hazards produced by wind turbines, airports have applied many different measures, such as Transponder Mandatory Zones (TMZ), procedural work around, area radar blanking, assuming traffic is maintaining straight and level flight, leaning back radars to avoid the turbine clutter, applying high levels of filtering, applying non-automatic initiation (NAI) of tracks and providing additional in-fill radars. A number of these measures help in certain conditions. However according to the UK's CAA, "not all the mitigation methods will be suitable in all circumstances and more than one method may be required to mitigate risks to an acceptable level".

With these challenges in mind, governments and the aviation sector are turning towards industry. The expectation is that radar manufacturers will develop new technology that can mitigate the detrimental effect of wind turbines on ATC radars and allow the coexistence of wind generation and aviation.

Superior detection, performance and accuracy

Hensoldt's latest ASR-NG radar has been specifically developed to ensure safe ATC service provision in highly dynamic cluttered environments.

ASR-NG is a multi-beam long range 3D S-Band solid-state approach and en-route primary and secondary surveillance radar with a proven wind farm mitigation capability.

While previous generations of ATC radars could not suppress false alarms originating from wind farms, ASR-NG provides highest detection, resolution and tracking performance by using triple-beam processing and electronic beam processing capabilities. The system implements a fully digital doppler detection and tracking solution with flexible and self-learning Clutter and Site Optimisation Capabilities.

ASR-NG also provides the class leading feature of 3D target detection. The three beam design of the antenna system and the data processor allow the measurement and calculation of altitudes of aircraft and other targets. The three independent beams provide a shape that allows for a superior elevation beam shape design.

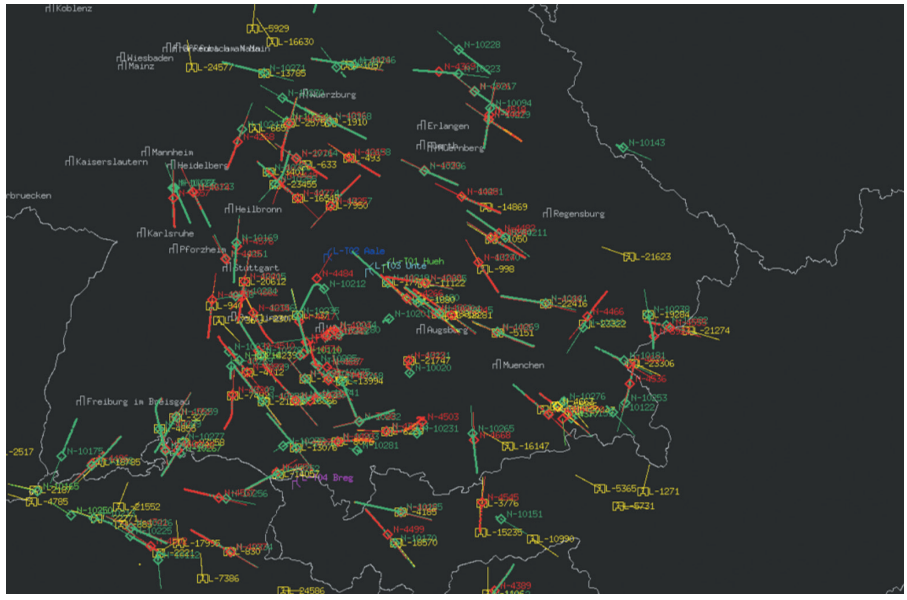
Traditional single beam radars and radars with concurrent processing of two patterns do not provide sufficient amplitude differentiation for wind farms mitigation. The UK CAA notes adverse impacts of wind turbines on secondary radars and in this respect as it states in CAP670, Traffic Services Safety Requirements, that 3D Radars are 'the ideal solution for wind farm primary radars'.

ASR-NG can detect, track and provide a height readout on manoeuvring targets above wind farms with its PSR, independent of the SSR.

ASR-NG provides long range coverage of up to 120 nautical miles (220km) in range. Alternatively it can be employed as a 60-80 nautical mile (110-150km) medium-range system. The extended range of the ASR-NG is an important benefit as requires fewer radars to deliver coverage area of a large geographic area.

Futureproof system

The sensitivity of the ASR-NG system delivers class-leading detection performance



Above: Twinvis Multiband Solution integrated in a 20ft shelter

HENSOLDT'S RADAR HERITAGE

Hensoldt and its predecessors have a long history in ATC radars. The SRE-M was built under US license in the 1950s. The successor SRE-LL and SRE-M5 were developed in the 1970s and 1990s by Telefunken in Ulm, Germany. With ASR-E (experimental), the prototype for ASR-S, the era of semiconductor transmitters was started in 2001. The new millennium started with the ASR-S (series or S-band) type which led to the current model family of ASR-NG (next generation).

In parallel, from its origins in 1964 from Siemens, Hensoldt has gained more than 50 years of experience in developing SSR interrogators. The company is well suited together with partners for automation systems, radios and infrastructure experience to provide a single radar sensor or a turnkey solution.

Hensoldt has contracted 49 ASR systems since 2008 for civil and military customers in Australia, Austria, Canada, Germany, the Netherlands, Switzerland, and the UK.

Hensoldt is a leading defence company with a global reach. Hensoldt develops innovative and customer-specific solutions in the fields of radar, electronic warfare, avionics, and optronics. As a technology leader, the company expands its portfolio continuously to combat a wide range of threats.

assuring safe detection performance against future composite airframe materials and very light aircraft / UAS.

ASR-NG is engineered in a modular form, easing the refresh of system functionality during its long service lifetime.

Filling the air picture gaps

As we have seen, the proliferation of wind farms has generated a significant and growing surveillance challenge. An additional wind farm mitigation solution is the use of passive radar detection.

The Hensoldt Twinvis passive radar can be used as a new instrument for monitoring the airspace at small and medium sized airports that are not equipped with primary radar. Twinvis also provides support in areas with severe restrictions, such as mountain slopes or where other obstacles impede normal radar frequencies.

Twinvis characteristics inherent multi-static operation, low frequency scattering and immunity against interferences and jammers lead to a very robust air picture which has been demonstrated and proven at wind farm mitigation trials with different aircraft and altitudes.

The passive radar proved to be extremely effective against all wind turbine effects.

In typical air surveillance environments Twinvis can detect and track air targets at a range pf up to 135 nautical miles (250km) and an altitude of up to 49,000ft. With an update rate of one second, Twinvis provides a very reliable 360° / 3D air surveillance picture and can also track extremely agile air targets.

The Twinvis passive radar system is already processing existing analogue and digital radio and TV broadcast transmitters. It provides an accurate sky picture in the absence of transmitters. As well as being able to work as a hidden, non-detectable radar sensor – "seen without being seen" – it has the major advantage of being a consistent system, not creating any electromagnetic pollution and consuming very low amounts of power.

In addition, the Twinvis can be easily clustered by combining sensors to extend the range and further improve accuracy.

Twinvis' low life cycle costs and easy installation makes it an affordable radar system for nationwide air surveillance. The sensor can be used as a fixed installed system on can be mounted to a mast or roof of a building, semi-mobile in a shelter or installed in a vehicle for mobile operation. Its standard Asterix interface allows for the operation of the radar locally or remotely.

The absence of any transmitter in the system brings additional advantages such as: high reliability, no need for a radiation permission, no negative effects on other services, low infrastructure needs in terms of weight, power and cooling and low life cycle costs in terms of both procurement and ongoing maintenance.

These advantages, combined with the fact that Twinvis is a standard Hensoldt product in serial production make the system a very valuable sensor for lots of use cases in air surveillance and air defence, security and protection of critical infrastructure, border surveillance and wind farm mitigation. Wind farms are here to stay and as the EU targets shows, they will increase their footprint throughout European territory.

The latest climate change targets mean that wind operators and the aviation industry will need to work harder to coexist in the same limited airspace with the support from radar manufacturers.

As recognized for its sensor capability, Hensoldt has taken on the challenge to answer the needs of both the aviation and renewable energy industry to insure a safe environment for their future coexistence. ❖