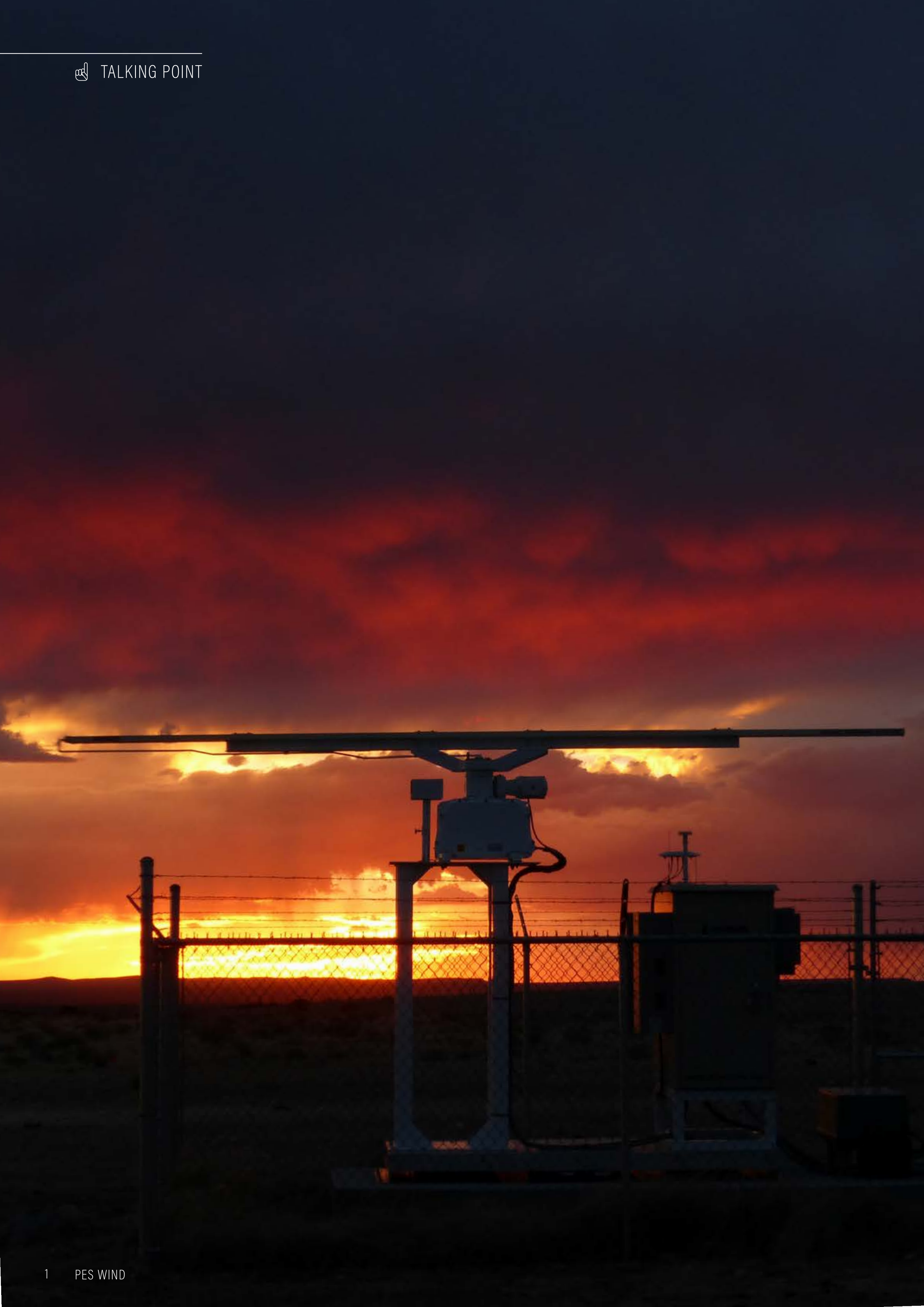
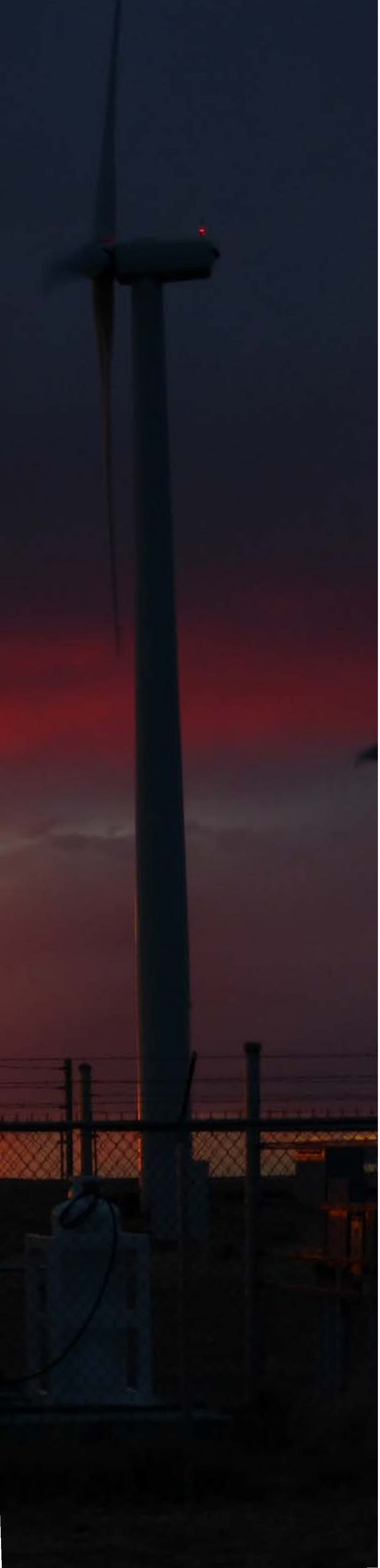




Be a good neighbour and keep the lights off

Words: Helen Lewis, Marketing Manager, DeTect

Following up on its 'avian monitoring on the radar' article in the last edition of PES Wind, DeTect makes a welcome return with an introduction to Aircraft Detection Lighting Systems. How is the technology being used to monitor airspace around wind farms while reducing light pollution?

An Aircraft Detection Lighting System (ADLS) is a sensor-based system that monitors the airspace around a wind farm, activating the obstruction lights only when aircraft are within a delineated buffer zone. ADLS technology originated from the 'Dark Sky' movement in the 1950s, when astronomers were concerned that nocturnal skyglow from urban areas was blotting out stars. In 1988, the International Dark-Sky Association focused on 'excessive use of artificial light' in remote areas. The use of ADLS today at wind farms is primarily being driven by nearby residents objecting to the constant flashing of the lights on turbines at night.

In 2011, the US Federal Aviation Administration (FAA) started researching radar-activated obstruction lighting technologies and issued performance standards in an Advisory Circular (AC 70/7460-1M, Chapter 14, 'Aircraft Detection Lighting Systems' November 16, 2020). Other countries including Canada, Australia, and Germany now have similar standards. Several US states, including North Dakota, Kansas, and Colorado have now mandated ADLS for new and existing windfarms. Other states and some local jurisdictions are also now requiring or are working on regulations for ADLS.

How does DeTect's HARRIER ADLS work?

In operation, an ADLS continually monitors the airspace around and above the wind farm for aircraft. When an aircraft is detected crossing a pre-set boundary, the system turns on the obstruction lights, keeping them on until the aircraft clears the control area (Figure 1). The FAA activation zone includes a 3-nautical mile buffer around each obstruction and a 1,000-foot buffer above the tallest obstruction. Most ADLS systems are tower or turbine-mounted within the wind farm to provide full, unobstructed 360° monitoring of the airspace. For large wind farms or sites with complex terrain, multiple radar units may be required for full coverage.

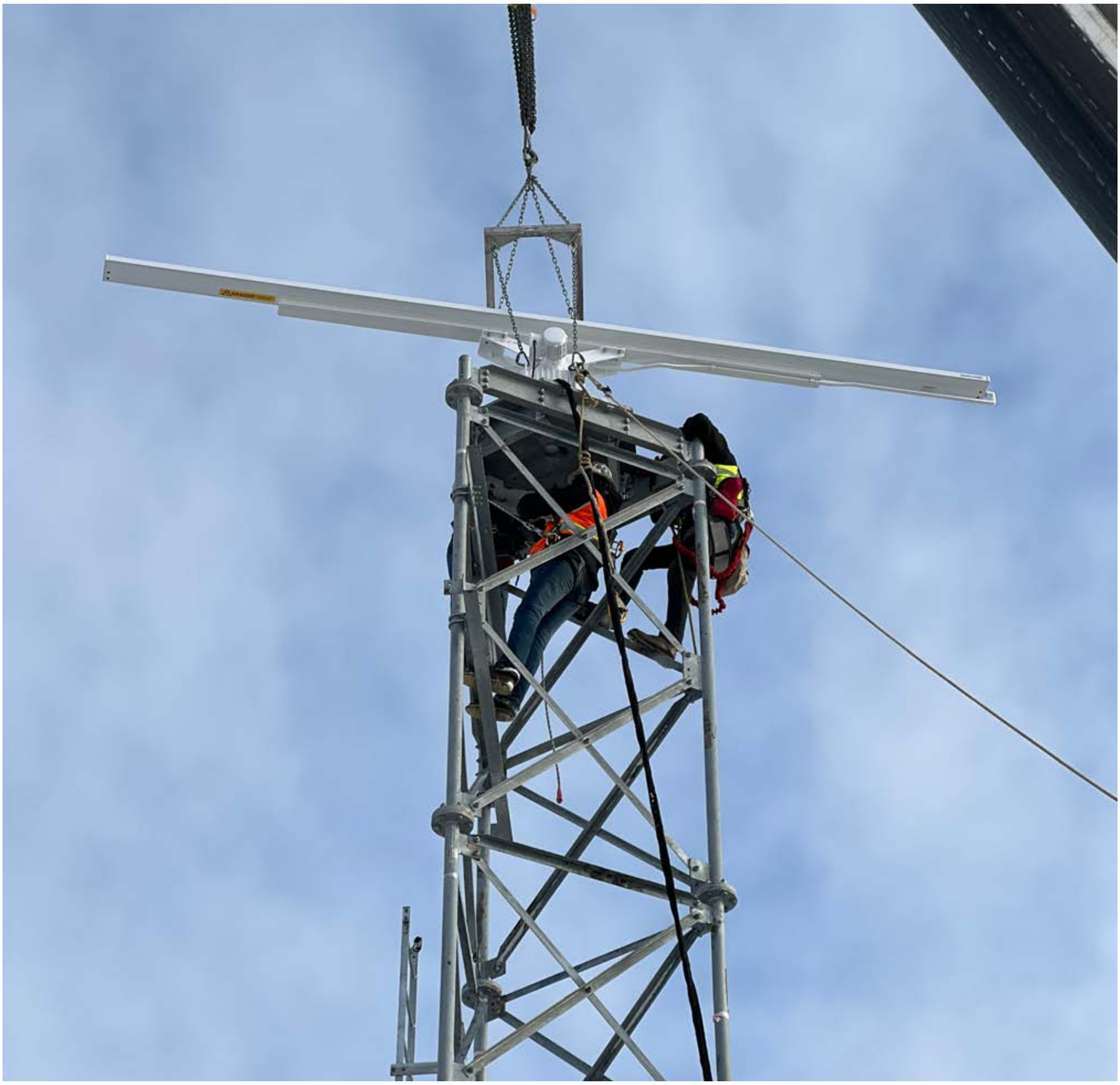
An ADLS is not just a radar, it is comprised of the radar(s), the obstruction lights, and necessary infrastructure. The radar system includes the processors, operating software, data system, radar towers, backup power, and SCADA network interface. Radar tower height is determined by line-of-sight modeling to provide full coverage. The obstruction lights also must be 'ADLS compatible' and connected to the wind farm fiber optic network. Each radar unit requires power and fiber from the closest turbine to the radar for connection to the wind farm network.

Helen Lewis

The HARRIER ADLS systems allow for sensitive processors and electronics to be installed in the windfarm operations building, with only the radar sensor installed at the tower site which reduces O&M costs.

To determine if a wind farm is a candidate for an ADLS, GIS and viewshed analysis of the site is conducted to define the number of radar units required for complete airspace coverage and locations for the radar(s). Special siting considerations include radar beam blockage by terrain, structures, and other obstacles, e.g., tree lines, lattice vs monopole towers or raptor issues, onshore vs offshore installation, light compatibility, availability of power and fiber to the radar, local aircraft activity levels, and other factors such as land access, and cultural/natural resource areas. The viewsheds are analysed at various aircraft altitudes to ensure that aircraft are fully 'visible' to the radar.

ADLS uses Operational Risk Management (ORM) algorithms and operates in a failsafe manner, where the lights are held in an 'on' state by the system unless no aircraft are detected within the defined risk zone. When the sensors detect an aircraft, the obstruction lights are activated. A 'heartbeat' indicator provides constant system status readings of the ADLS and its network. Should the ADLS go offline, or if the heartbeat indicator is lost, the lights will automatically activate and remain illuminated until the system returns online and confirms no aircraft are in the risk zone.

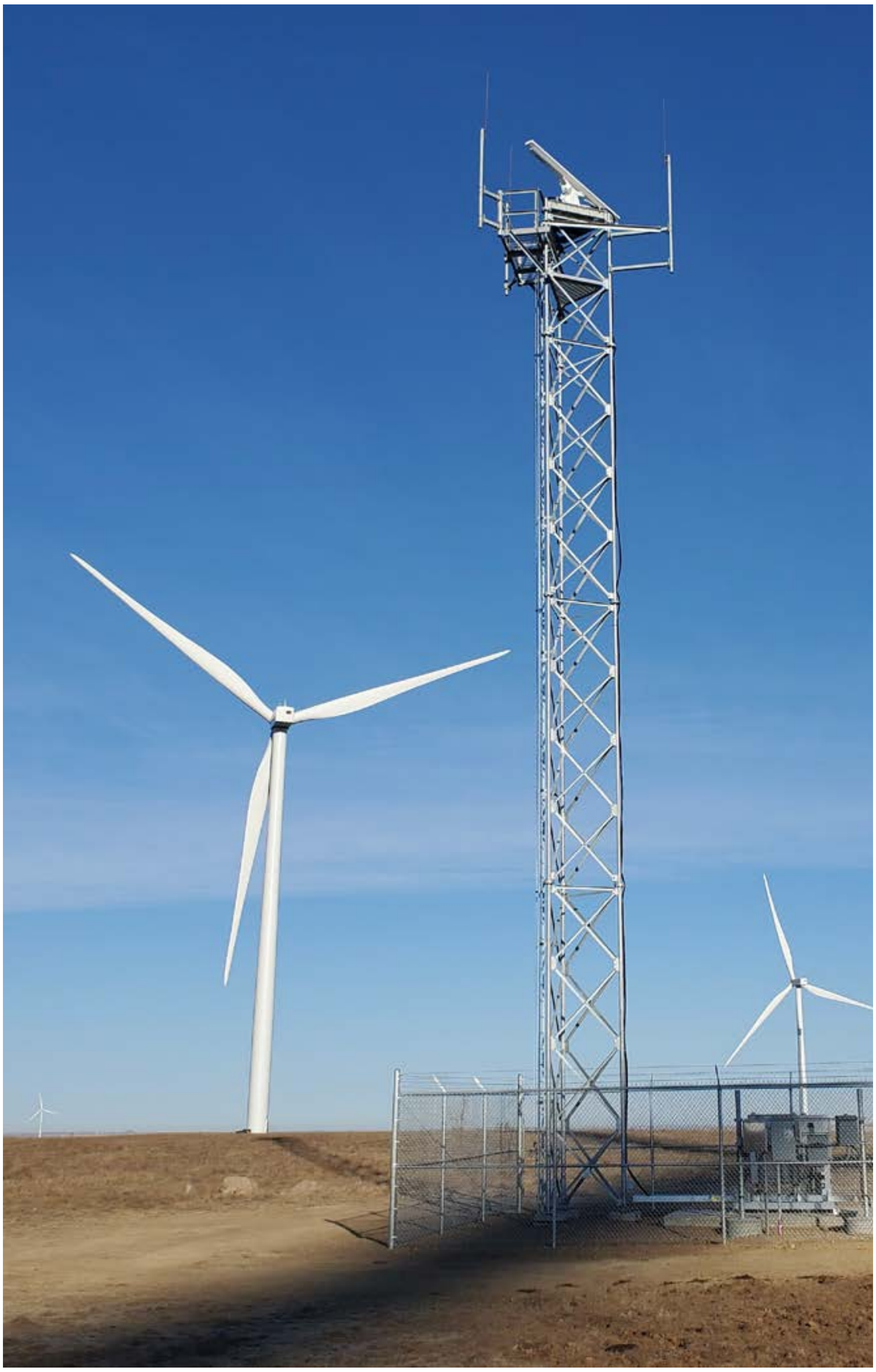


Once the final turbine and radar locations are set, the owner files the ADLS Obstruction Lighting Plan with the FAA. The package includes the location of all turbines and radars and viewshed maps at various altitudes ranging from 200 to 1,000 feet. DeTect assists with the preparation of the package at no charge to the client.

At this point, the infrastructure and construction requirements and costs can be determined, including costs for running power and fiber to the radars, tower foundations, network interfacing and cyber security, and obstruction lighting connection to the windfarm network. For older wind farms, the lights may not be compatible or upgradable and may need to be replaced. Scope of work assignments can vary from the ADLS vendor supplying only the ADLS radar, and related services with a general contractor performing the construction-related tasks to full turnkey delivery.

Project schedule

The typical ADLS project takes eight to 10 months from system manufacture to installation, commissioning, and turnover. However, some supply shortages are still in effect, so clients are informed that it could be nine to 12 months until commissioning. After installation, the start-up of the ADLS is fairly short, with the system operational within a week. It should be noted, however, that optimization of the lights off/on periods to the lowest safe level can take up to 60 days, as the data from the radar undergoes QA/QC and filters are developed for non-aircraft targets, e.g., birds.



Lessons learned

ADLS today is a proven, reliable, and widely deployed technology, but there have been many lessons learned. A key lesson from dozens of ADLS installations over the past few years is that developers need to be careful how they present the ADLS to public stakeholders; while most projects are seeing lights off periods of more than 95%, there are sites where aircraft activity is high that increases lights on periods.

Additionally, during spring and fall bird migration periods, lights on times may increase as some bird activity can be seen by the radar as potential aircraft.

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The ADLS technology at a glance

HARRIER X-Band radars can detect a Cessna out to 12 NM, while the HARRIER X Band frequency diversity (FD) can detect and track Cessna out to 16 NM.

The HARRIER ADLS is multi-function capable and can provide surveillance coverage for aircraft and bird detection, for environmental monitoring and collision risk mitigation from a common sensor platform.

The technology meets or exceeds all regulatory requirements, including the recently issued US Federal Aviation Administration (FAA) Advisory Circular and Canadian NAVCAN requirements, as well as various EU standards.

The HARRIER ADLS is highly customizable for each site and application, with multiple alert zones and activation perimeters, and is available as a stand-alone system or integrated with other sensors and warning devices such as audible beacons.

The typical national standard (FAA AC 70/7460-1M, Transport Canada) minimum range is three to four miles. HARRIER exceeds this expected minimum by a safety factor of more than 400%.

Additionally, its speed measurement and heading monitoring exceed agency requirements for range for detection and activation.