Combating 'light pollution' with grit and innovation

Lights out: the first transponder-based ADL system was activated recently in Northern Germany

One of the most pressing issues when it comes to making wind energy fit for the future is the aspect of acceptance: acceptance among the broader public, but especially among those directly affected by it, the residents and the environment. Transponder-based aircraft detection lighting systems (ADLS) offer a sustainable solution putting non-stop blinking obstruction lights to an end and bringing back dark night skies.

It was almost twenty years ago when Gerd Moeller, General Manager of Lanthan GmbH based in Bremen, Germany, was first confronted with the question of how to solve the problem of 'light pollution', an issue that residents, as well as the environment surrounding wind farms, are quite literally facing every single night due to the red obstruction lights on the wind turbine generators (WTG) blinking non-stop to ensure that the WTGs are always safely visible to aviation.

'In 2002, we were already being confronted with the problem of acceptance by residents. Our first measure was the technical and legal implementation of the visibility range control. In this case, the obstruction lighting would burn less brightly in times of good visibility. In 2004, we were first introduced to the concept of on-demand lighting – lights that detect aircraft. It was back then when we were first approached to come up with a transponder-based solution for an aircraft detection system. Our first reaction was rather reticent, but luckily, we were wise enough to give up our resistance and, instead, started to focus on this.'

The first pilot project took place at a wind farm in Wiemersdorf, Germany. 'The air force squadron of the German Federal Police was stationed right next door. And there was an actual need: even though the WTGs by manufacturer Enercon were not more than 100 meters tall and therefore did not require obstruction lights per law, we were asked to install our transponder-based aircraft detection lighting system (ADLS). The project was a great success and has been up-and-running for the past ten years.'

What followed was a lot of hard work and energy that went into further developing the transponder-based ADLS as well as gaining approval for this comparatively young technology. Despite its frustrations and bureaucratic hurdles, the venture proved to be successful, as a broad consensus was eventually achieved. New regulations brought into law in countries such as Germany, but also in the ICAO, the world's highest-level international civil aviation authority, now allow the use of transponder-based ADLS technology. The German government has even taken it one step further, as it has become mandatory to install on-demand aircraft detecting lights for both existing as well as newly-built WTGs. Operators are now legally required to have an ADLS, whether radar, or transponder-based, installed and running by the end of 2022.

This decision by German lawmakers prompted the founders and central players of the successful companies Lanthan, Air Avionics, and RECASE to join forces to combine the bundled expertise of a leader in aviation obstruction marking technology, an aerospace approved manufacturer of avionic instruments and an experienced engineering and consultancy service provider in the field of renewable energy. The three companies started working together on transponder-based ADLS many years ago, with a mission to create safe, market-mature, cost-effective, and sustainable ADLS products. Therefore, the founding of Lanthan Safe Sky GmbH was a logical next step, focussing on the widespread implementation of transponder-based ADLS.

In the spring of 2020, an eventful year by all measures, Lanthan Safe Sky (LSS) was founded and hit the ground running. From a team of 12 experts in the areas of aerospace, aviation obstruction markers, project management, and wind energy, LSS has grown to include over thirty employees. As the first supplier of a transponder-based ADLS to have passed through all the licensing and approval processes, Lanthan Safe Sky was able to secure orders to equip more than 3,000 wind turbines in its first year of business.

But what is it that differentiates a transponder-based solution from a

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radar-based system? Aside from the fact that it is free from emissions and does not require frequency assignments, the most significant advantage is that it safely detects aircraft flying very low. While radar-based systems are faced with limited coverage close to the ground, for example due to reflections by buildings, vegetation, and terrain, the transponder-based technology uses signals which are sent out by transponders in aircraft. These signals are sent out by all aircraft flying at night and can be received readily, even if being reflected or shielded.

Steven Siemen, Project Implementation Lead at LSS, explains the details: 'We reliably monitor the relevant airspace, from ground level to upper airspace. The fully developed and field-proven detection technology is not only based on all legally required signals, but analyses further aviation signals coming from aircraft. Moreover, the signals received by all ADLS worldwide are put together to a comprehensive picture of the current air traffic situation. By this means, particularly low operational costs without maintenance effort on-site can be realized while safety requirements are not only met but over-fulfilled.'

When it comes to the concrete numbers of beaconing off-time periods, the outcome depends on where the wind farms are located. 'In most cases, we can reach close to 100 percent light-off-time. But even in the airspace close to airports, we can reach average values of 98 percent, which is a positive surprise to many operators,' says Managing Director Mitja Klatt.

From an operator's point of view, there are several crucial aspects to keep in mind: one of them is the provision of a stable internet connection, which is a prerequisite for the operation of the ADLS system. This can be provided on-site or it can be implemented by using an already built-in mobile communication system in the ADLS.

The average data volume that an air traffic receiver ATS-3 consumes is about 1 GB/day. Interface modules ATS-4, which are optionally used in systems without traffic receivers to control the hazard beacons, require less volume, approx. 100 Mbytes/ day. The speed should be at least 0.5/ 0.3 Mbit/s, upload/download, with a ping of <100ms to a domestic server.

Another relevant question often asked by operators is whether every single turbine has to be equipped with a traffic receiver. 'The answer is no. Our air traffic system ATS-3 covers a safe detection area of 10 km. The activation area of individual WTGs has a radius of 4 km – that is the space in which the beaconing has to be activated. Activation areas have to be included by the detection radius. Thus, a WTG cannot be located farther than 6 km away from the WTG with the traffic receiver. In many formations it is possible to cover many WTGs with one single receiver,' Steven Siemen points out.

Despite the favourable legal framework and the speed with which LSS was able to move forward with the installation of its ADLS system, mostly thanks to being the first certified provider, the process which ultimately leads to successfully switching off the hazard lights isn't exactly a walk in the park. 'Especially the regulatory specifications, or lack thereof, were often rather confusing and tedious for everybody involved and proved to be the most time-consuming challenge. But it was also a valuable experience that ultimately resulted in a steep learning curve for us and every other provider of ADLS. Being the first company to overcome this final threshold in the process makes us proud and very optimistic that the path for a swift installation of our ADLS across Germany and its neighbouring countries has now been cleared,' says Marc Foerderer, Head of Marketing and Business Development.

With regards to the price tag, there is no one-size-fits-all approach. 'Our offers are individually tailored from single WTGs up to complete parks, from individual plants to cross-national clusters. By offering tailored products, such as a signal provision contract, we aim to provide affordable solutions for smaller projects as well. It is important to emphasize that there are no hidden costs as these can be immense, especially for relatively inexperienced operators. We offer our

products fully licensed, which means there are no patent-related risks for the operators. Additionally, we provide support for the approval process on-site with extensive documentation as required by each local authority,' explains Steven Siemen.

The first project to be completed is a wind farm in Schleswig-Holstein, Northern Germany, consisting of six WTGs: in February, the transponder-based ADLS went live for the first time worldwide. One predictable realization for the team: the process is not without its complexities, especially as several parties are involved. 'We experienced some technical challenges immediately before going live. These were mainly in relation to WTG IT systems, interfaces, and networks. Even though we were able to put this teething trouble behind us rather quickly, we all breathed a collective sigh of relief when the system was up and running without a glitch,' reveals software developer Tobias Fetzer.

Neuengoers in Schleswig-Holstein is therefore not only a world premiere but will also serve as a blueprint for further projects which will shortly follow. 'We are confident that in the near future a growing number of parks will switch off their obstruction lights,' says Mitja Klatt. 'Even with the legal deadline being months away at the end of 2022, both residents and the environment benefit from a more rapid implementation. Every obstruction light being turned off is one more step further into the direction of sustainable and future-oriented wind energy.'

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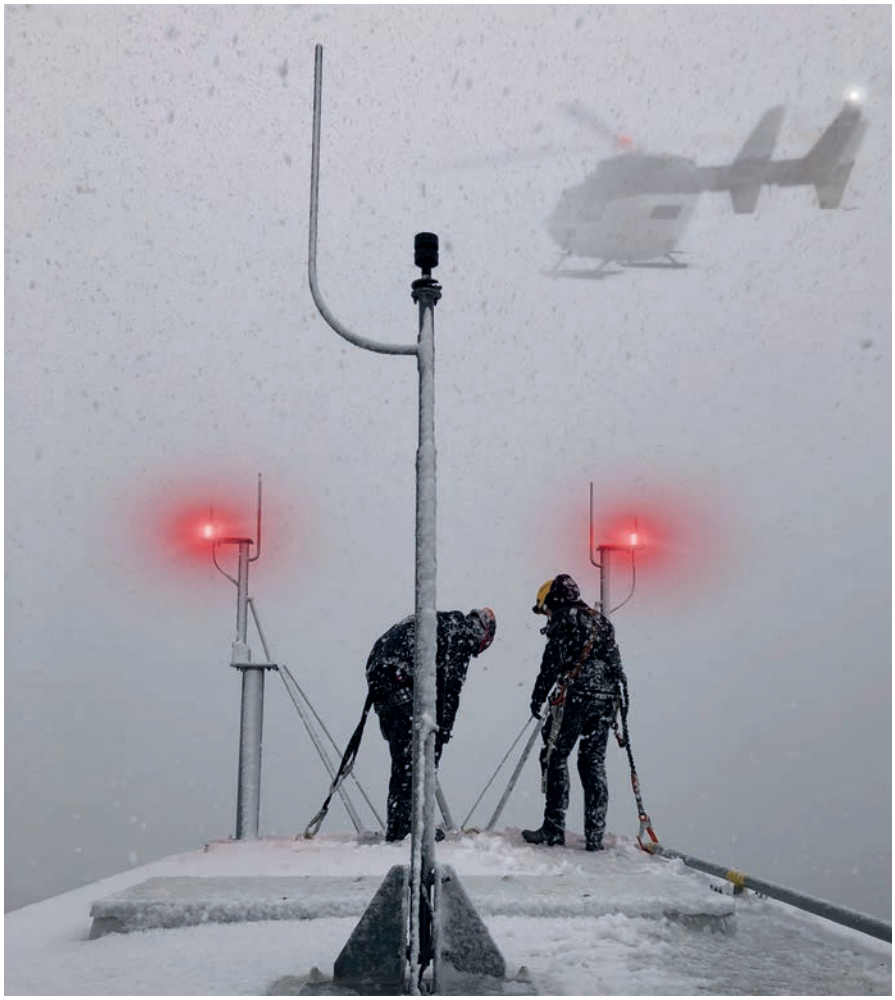

The work continues despite the sometimes harsh conditions

Reducing light pollution to a minimum also benefits the environment