

Wind turbine and grid inspection services

This document is an overview on the data acquisition part of drone based wind power inspection services. We do also provide end-to end inspection services including reports which is not covered by this document.

VisiorIM

VisiorIM is operating in 3 areas:

- Management consulting, wind power project, environmental and commercial consulting
- UAV based inspection services for wind power and other industries,**
- R&D focusing on environmental surveying and inspection using drones and RC camera systems.

VisioUAV

Main points of our UAV operation

- We provide rotor blade, tower and Nacelle inspections as well as power lines and substation inspections
- We are mainly operating in Scandinavia, Germany, Netherlands, Austria and Southern India.
- Providing the actual data acquisition and if also required the complete end to end visual inspection from data collection to analysis and reports
- Inspections for asset management, wind turbine manufacturers and investors
- Recurring, on demand, warranty inspections and emergency on call services
- Efficient, UAV based using our command vehicle with special antenna and monitoring facilities.



Organization

VisiorIM comes with 5 years of experience in drone-based flight surveys and 17 years of experience in data analysis and reporting. Our office facility is located in the municipality of Timrå, Västernorrland, Sweden with a remote data service office in India.

Rotor blade and other industrial inspection

We cover the complete end to end process for rotor blade (tower and Nacelle) inspections. This document focuses on the data acquisition only. We provide data acquisition with focus on:

1. Fast and efficient inspection process
 - 🌍 We do not require driving to each wind turbine but instead inspect remotely with up to 2km distance to the wind turbines without changing batteries and returning. We can usually cover 4 wind turbines (sometimes 8) from one location. Usual productivity per team is 6-11 WTGs per day.
 - 🌍 In order to handle sunlight issues and keep a stable image quality we are fast in accessing the wind turbine's control system in order to adjust for the flight. This is partly done while being airborne.
 - 🌍 Logging in/out registering at the WTG and communication is done according to the client's standard.
 - 🌍 Efficient planning and communication is the key for efficient inspections.
 - 🌍 Visiorim is using AeroEnterprise's flight intelligence system for enhanced source data
2. Quality of image data

The image quality not only depends on the camera in use but strongly on the pilot skills, (sun)light condition handling as well as overlap handling. In order to make sure our pilots can handle this our missions control station is equipped with larger passenger OLED screens and the pilots are trained for this specific procedure. As of 2023 an automated flight procedure is in place using LIDAR and AeroEnterprise's flight intelligence system where image data is further improved and the inspection part is automated.
3. Weather and working condition optimized set up.

Weather conditions affect both timelines and quality and thus productivity.

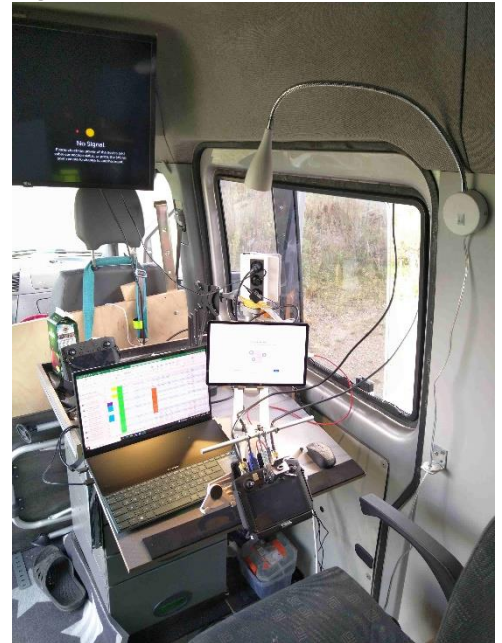
 - 🌍 There is sunlight that makes drone and details "disappearing" as well as images below accepted threshold of quality. In northern Scandinavia this is especially challenging.
 - 🌍 Further there can be low temperatures affecting the pilot's finger-motoric abilities for fine adjusting the flight and making long runs impossible.
 - 🌍 In Summer we use to deal with mosquitos highly distracting the pilots.
 - 🌍 Another, for us very important part of delivering high productivity for larger inspection runs is the working conditions in the field. Standing or sitting outside remote controlling the drone day after day increases the risk of failure and very often is not even possible due to above listed conditions or simply fast changing weather conditions where quick action is required.
 - 🌍 Last not least we can work off-grid for several days
4. Reliable partner getting the job done and communicating with all stake holders

- 🌐 We are experienced and trained – also in northern Scandinavian off-grid missions.
- 🌐 We communicate pro-actively status and potential issues
- 🌐 We work solution oriented which includes flexibility

Our answer to this all is:

We inspect from inside a darkened mission vehicle equipped with:

1. Mission control desk with ergonomic chair and remote controller mount adjustable to detail
2. Roof mounted antenna system with camera spotter observation
3. Off-grid heating and AC
4. Basic kitchen facility for proper food and coffee during the long days of inspection
5. Laptop desk, internet connectivity with industry grade router and directional antennas in order to maintain contact to WTGs and the outside world.



Our experience

- 2021& 2022 rotor blade inspection for Nordex in Germany (Delta turbines in Sept., Oct)
- 2021 Haltern crash site inspection and tower inspection for Nordex
- Drone surveying for environmental purpose as of 2016
- Drone surveying for electrical power line and wind farm internal grid planning since 2017
- Transformer station planning missions as of 2018
- Environmental research project for Golden Eagle surveying

We have two trained pilots as the core crew and access to two more pilots on demand.

Following courses are done for Robert Kalcik. All other courses and crew on demand.

1. HLR (first aid.- heart and lung rescue certificate 2021)
2. Electric instructed person course (Robert Kalcik has a background in electronics also)
3. Work safety course
4. Nordex NC2 /delta course

Robert Kalcik designs and writes control programs for wind farms and is thus aware of all relevant circumstances during operations of a wind farm as part of TCMA agreements and asset management processes.

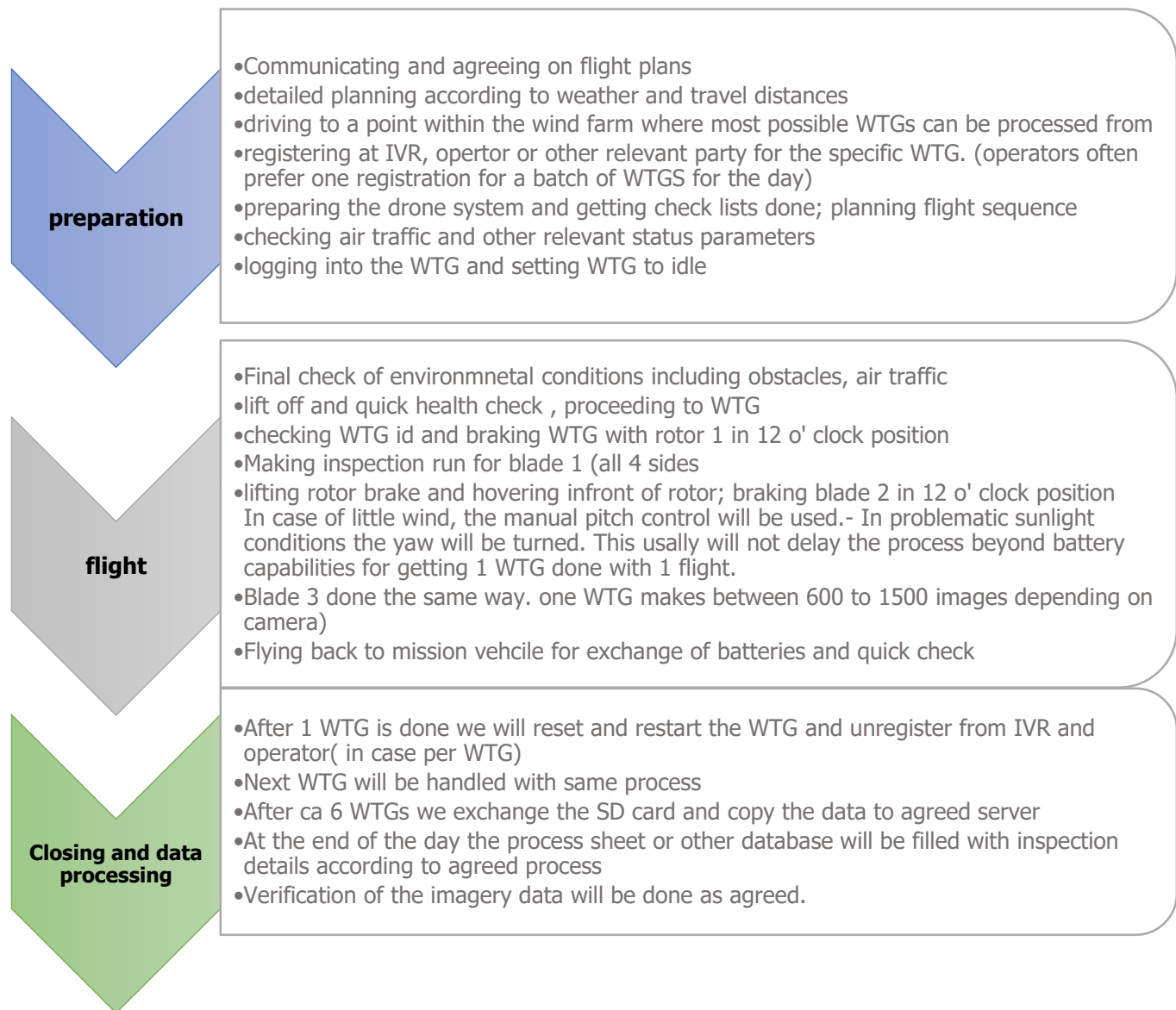
He also works since 2010 in the wind farm business developing the wind farm Stor-Skälsjön with 260MW in the Nysäter cluster in Mid-Sweden. Further he works as consultant for other wind farm developers in the planning process as well as due diligence and procurement.



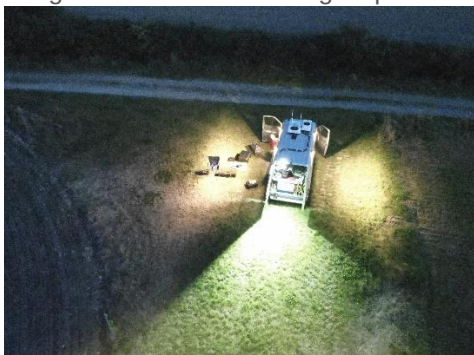
during Nordex inspection,
Germany, Garzweiler 2021

Process of data acquisition for wind turbine rotor blades

The process is optimized for Scandinavian weather and remote site located conditions with field experience since 2010 in Norrland, Sweden. Inspection protocols are agreed and followed with all inspection runs.



Images are reviewed during inspections in our mobile facility, backed up and uploaded to the agreed server.



Technology and facilities

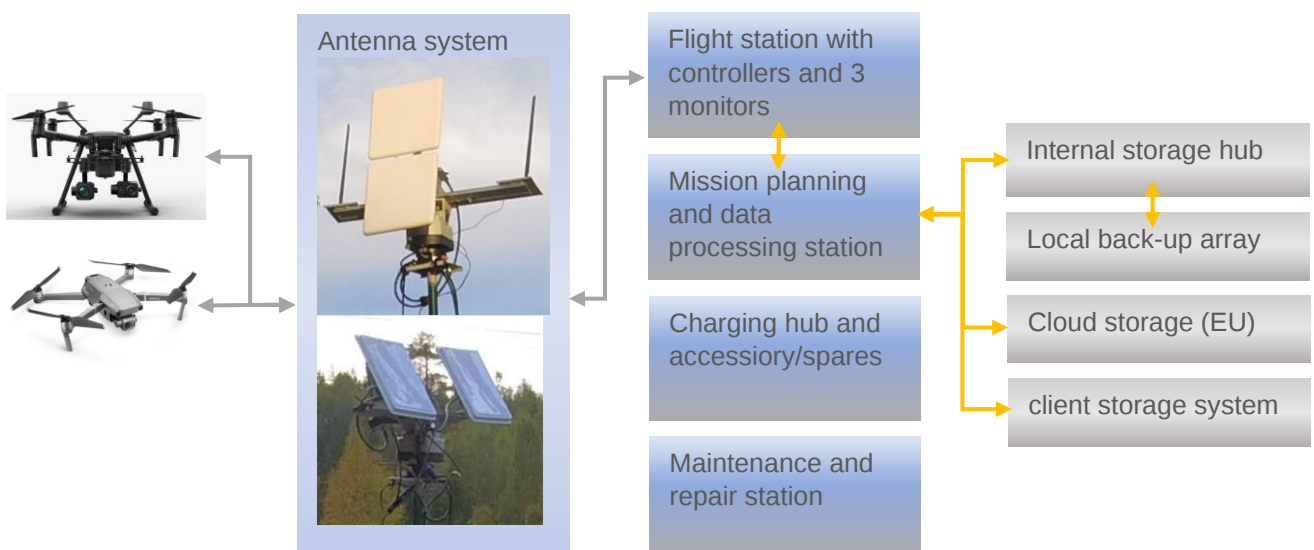
Basically, there is the drone system and the mission facility. Both with some redundancy for continued operation

- 3 drones used; choice is depending on the mission
- Various antenna systems for increased safety and reliability
- Modular office stations that can easily be moved between mission vehicles
- Vehicles adapted to missions: van, truck, modified BV206 rubber track vehicle, mission and workshop trailer with wheels and skis. Ready for on-call missions

This modular approach enables to adapt to the project and operate flexible on site. The different vehicles enable us to cover a wider area and adapt to the size of the project.

Overview

- UAV based system with visual and thermal cameras, 2 sets with a 3rd for redundancy
Matrice 300RTK drone with H20T and P1 payload cameras
 - Mavic 3 drone
 - Directional and omnidirectional antenna system,- vehicle or mast mounted
 - For critical missions we've got an auto-tracker directional antenna system with high zoom camera to follow the drone automatically.
- Mobile mission office facility
 - PC desk
 - Drone deployment platform
 - Ergo-chair with adjustable arm rests
 - Remote controller mounts with arm extensions for both in- and outdoor use.
 - 1 external OLED tablet and OLED passenger screen
 - 1 additional screen to follow camera spotting
 - Battery charging rack
 - Tool rack and work bench
 - Spares and maintenance rack
 - Kitchen facility
 - Fuel and electrical heating, AC
 - Industry grade 4G network access router with directional roof antennas
 - Bathroom, toilet, 2 beds and drone deploying hydraulic platform (in the mission truck vehicle)
 - Auto tracking antenna system for critical missions
 - Sonic insulated, capsuled electrical generator AC 4000W electrical supply for off-grid supply



Collection of photos from recent missions

This includes images from the 2021 Nordex inspections

