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DISTRIBUTION**

Serving the Midlands, South West and Wales



AIR POWER

Aerial inspection innovation

westernpower.co.uk



AIR POWER

Simultaneous visual, high-definition video and stills, thermal and corona inspections with high-density point cloud LiDAR capture by authorised personnel.

Western Power Distribution (WPD), geographically the largest Distribution Network Operator (DNO) in the United Kingdom, owns and manages an electricity network covering 55,500km² serving eight million customers.

In order to both proactively and reactively inspect its 92,000km of overhead network, one of WPD's unique capabilities is that it owns and operates five Airbus EC135 helicopters from its dedicated facilities at Bristol Airport.

WPD's helicopter unit will celebrate its 60th year of operation in 2023, having provided inspection services since its inception in 1963 for the Bristol Port Authority.

Since then the unit has amassed some 180,000 flying hours, which includes over 27,000 flying hours on the EC135, and patrolled in excess of 1.6 million kilometres of electricity network. Routinely, each crew and helicopter will be airborne for between 4.5 and 5 hours per day inspecting between 50 and 100km of the WPD overhead network and substations depending on complexity and voltage.

In a recent business as usual investment WPD has equipped all five of its helicopters with state-of-the-art cameras and a laser measurement system known as LiDAR (laser detection and ranging). This is to further the inspection capabilities that assist WPD in providing its world-class customer service by ensuring the lights are kept on.

This investment has built on what was an already specialist platform to produce a unique capability. WPD's aircraft and crews are now not only able to provide the existing well-proven visual assessments but, with the introduction of a third crew member, they can now provide a non-visual inspection and capture LiDAR data all on one flight.

The combination of the front-seated observer (WPD Authorised Overhead Inspector) and rear-seated mission system specialist brings the human and sensing technologies together.

The human's eyes, knowledge and experience amalgamated with cutting edge sensing technology provides an exceptional platform purposely designed for utility asset inspection.



55,500km²
electricity network coverage



92,000km
of overhead network



180,000
flying hours amassed since 1963



1.6 million
kilometres of electricity network covered



A bespoke system brings a different dimension

Whilst the individual items of technology were readily available as commercial off-the-shelf products they had never been used in conjunction or in parallel with each other; therefore airborne trials were conducted, facilitated by Nova Systems.

These trials clearly demonstrated that with the right configuration the sensor suite would bring a different dimension to airborne electricity network and utility inspection.

The investment allowed the installation of a gyrostabilised multi-sensing camera system provided by Trakka Systems, a purpose designed LiDAR system provided by Riegl, mission planning and mapping software provided by CarteNav and an array of computing power.



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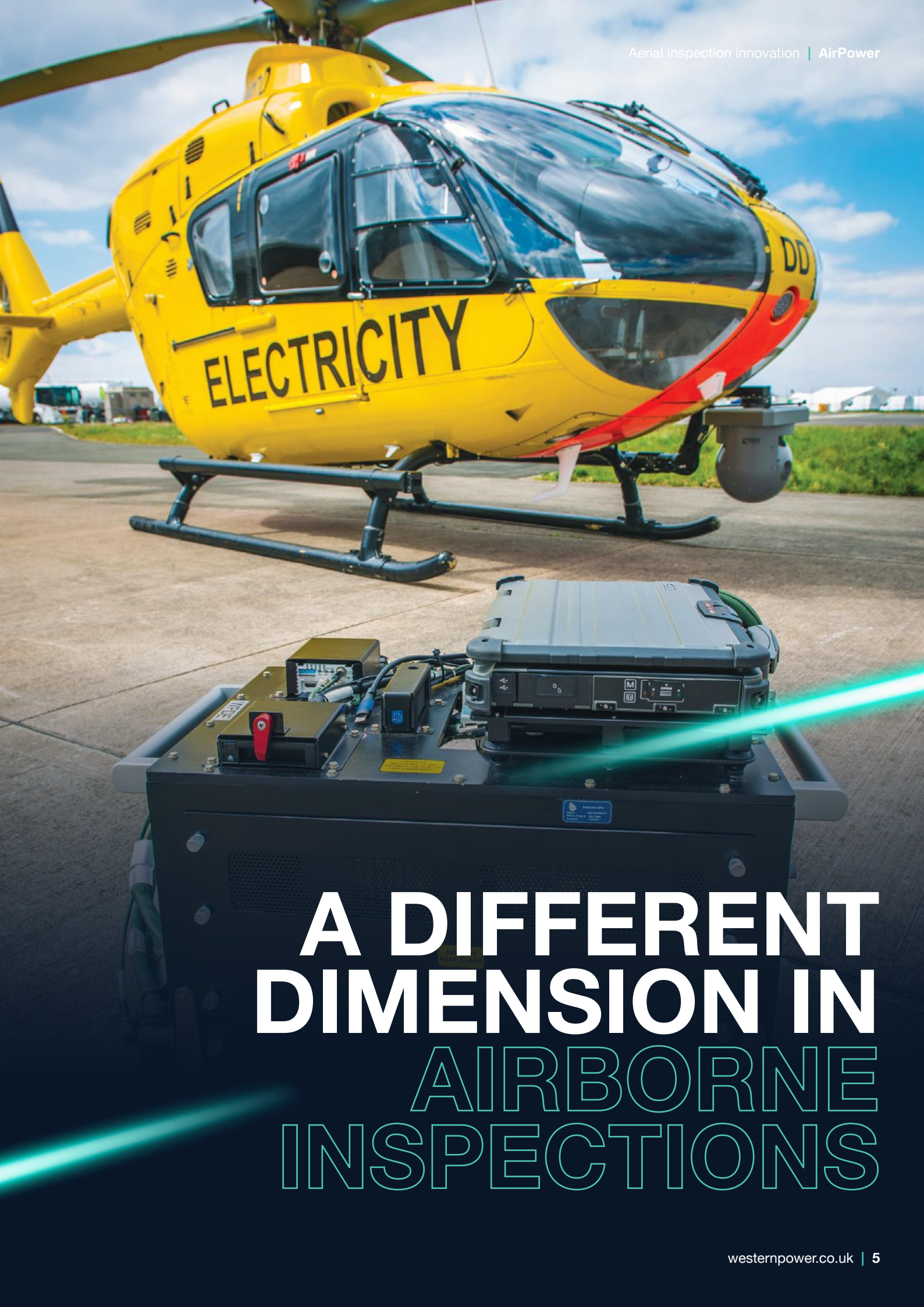
Nova Systems are really excited to be part of this technologically advanced innovative project. Being fully involved throughout the whole project lifecycle we were approached to design and install a prototype mission system installation on our Nova Testbed EC135 aircraft (G-NSYS) operating under an experimental permit to fly with a CAA low level exemption to allow for flight test, trial, and evaluation of the proposed LiDAR system away from the WPD operational aircraft.

This flight test analysis and data helped provide robust and supporting evidence towards the major investment required and fed valuable Installation, integration and data quality lessons into the future Mission System requirements. As all the WPD aircraft have entered and transitioned through modification we have continued to support WPD by providing ongoing technical and project management support in Aircraft Acceptance, Operational Test and Evaluation and also providing Mission Systems training.

We believe that by working together with WPD and the other stakeholders in this project we have helped create a definitive step change in the efficiency and quality of future UK power line survey delivering a truly world class capability.

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Andy Watson,
Nova Systems Project Lead



A DIFFERENT DIMENSION IN AIRBORNE INSPECTIONS



SEAMLESS OPERATION



Significant system integration

Bringing this comprehensive system together to allow seamless operation required some significant system integration. The system architecture, design and physical modification of the aircraft were conducted and completed by Babcock Onshore's Design and Completions team at Gloucestershire Airport.

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Babcock are pleased to have played a significant part in delivering this cutting-edge mission system to WPD, assisting in the management of the UK's essential power network.

Our involvement in the project has demonstrated our ability to design, manufacture and integrate mission systems for the most demanding of airborne operations, revolving around our collaborative approach with all stakeholders.

Due to the complexity of the mission system, we were required to utilise the full range of our capability and expertise, from conceptual design and schematic creation to installation and flight test, ultimately delivering certified aircraft modifications embodied across the WPD fleet.

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Ben Jones,
Technical Programme Manager,
Babcock D&C

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The creation process of the WPD mission system concept has been based on the deep understanding of the customer's operational requirements and the realisation of the full potential of the mission equipment, in an effort to achieve the perfect balance between innovation, ergonomics and friendliness of the Human-Machine Interface (HMI).

The ability of the WPD crew to use three mission computers via two keyboards, to visualise the related content on five touchscreen-capable displays and to control a variety of sensors (EO, IR, UV from the camera and laser scanner from the LiDAR), well describes the complexity of the technical challenge overcome by the Babcock Design & Completions team.

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Giovanni Russo,
Principal Systems Engineer,
Babcock D&C



Multiple inspections on one flight

The addition of the Trakka Systems SWE-400 Quad gyrostabilised cameras allows high definition visual inspection as well as radiometric (thermal) and corona (UV) inspections on all voltages.

This allows the observers and mission system operators to readily identify, examine, capture and report on defects including those that are not visible to the naked eye. The ultimate aim is to rectify these defects before they affect the end user and, in most cases, without the customer even knowing there was a problem.

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Trakka Systems is extremely pleased that such a significant electricity distributor has selected the TrakkaCam SWE-400 QUAD following a competitive tender to effect airborne inspections with their helicopters. Airborne inspections help reduce energy distributors' reactive repairs and unscheduled downtime to provide customers with an uninterrupted source of electricity. Trakka is proud to be the world-leader in this market segment today.

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Business Development Director
Trakka Systems AB

The camera is controlled through mission management software, designed by CarteNav, called AIMS. Using the camera's laser range finder and global positioning the software is able to accurately identify the aircraft and asset location in three dimensions.

Therefore when adding the WPD GIS data to AIMS this also allows presentation of the asset ID on the various displays in the rear and front of the aircraft, increasing situational awareness and further facilitating communication between crew members when on patrol.



IDENTIFY, EXAMINE, CAPTURE AND REPORT



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We are proud to see AIMS-ISR power Western Power Distribution's unique and powerful asset inspection helicopter fleet to keep the lights on across England and South Wales.

By utilising our image and video management tools within AIMS-ISR, Western Power Distribution can utilise UV sensors to see corona effects on power line insulators – logging captures and simply actioning for future maintenance activities.

As always, our goal was to use innovation to help our customers solve real-world problems every day.

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Carl Daniels,
COO,
CarteNav

Powered by AIMS-ISR, the five WPD asset inspection aircraft proactively monitor vast swathes of power distribution infrastructure.

Operator crews require reliable ISR platforms for daily line inspections and rapid response capabilities for emergency power outages. Augmented reality mapping within AIMS-ISR achieves this capability. Asset identifications are intuitively displayed on the EO/IR feed, providing exceptional situational awareness for managing the immense distribution network.

This situational awareness coupled with easy report generation and data logging enables complete asset inspection data distribution from airborne capture to crews on the ground.



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Aerial inspection innovation



“ A definitive step change in the efficiency and quality of future UK power line survey delivering a truly world-class capability. ”

Andy Watson,
Nova Systems Project Lead



Vegetation management and more

To assist with WPD's requirement under the ESQCR regulations to manage vegetation near to the electricity network, the decision was made to include a LiDAR system within the modification process. RIEGL, who are based in Austria and are renowned for the provision of world-class laser measurement devices, provided the VUX-1LR airborne laser scanner which is now fitted to all five of the aircraft. This scanner is a very lightweight and compact laser scanner, meeting the challenges of airborne laser scanning by helicopter both in measurement performance as well as in system integration.

The RIEGL VUX-1LR provides high-speed data acquisition using a narrow infrared laser beam and a fast line scanning mechanism. High-accuracy laser ranging is based on RIEGL's unique echo digitization and online waveform processing, which enables superior measurement results even under adverse atmospheric conditions, along with the evaluation of multiple target echoes.

The scanning mechanism is based on an extremely fast rotating mirror, which provides fully linear, unidirectional and parallel scan lines, resulting in excellent regular point pattern, over a 330° field of view, which allows for the scanner to be utilised within the standard flight profile of the inspection process.

Utilising RIEGL's Online Waveform processing and multiple target capability generates a highly dense and detailed point cloud, of not only the power line infrastructure such as WPD's poles and towers, but also the canopy structure of the surrounding vegetation. The system is also equipped with three cameras to allow for the point cloud to be coloured with RGB values.

This turns the point cloud from a typical 'greyscale' image taken from the intensity of the laser scanner to a 'real-life' coloured point cloud that can be useful for better understanding the details, especially for people unfamiliar with point cloud data. The images are geo-referenced and can therefore be used to locate individual tree species within the point cloud.

This assists improvement in the vegetation cutting plan based on the known growth rates of various species. This data and its associated visibility allows better and more informed decision making in planning vegetation maintenance along the various power line corridors.





RIEGL



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We are very pleased to be chosen to be involved in such a complex and professional system integration. From the earliest discussions we were confident that the VP-1 helicopter pod system would offer the high-quality data that is a core requirement of the project.

This was further confirmed with the test flights and data acquisition, where we simulated the various flying parameters that Western Power Distribution typically fly during routine inspections.

Our intention throughout these tests was to firstly prove the quality of the data and that the system would be a symbiotic addition to the platform, which did not require any additional or dedicated flight patterns to provide the data. We are excited by the potential of the multi-sensor platform that WPD has developed, and see it as a pioneer in such a complete offering for power line inspection.

”

Andy Fuller,
RIEGL

WORLD-CLASS LASER MEASUREMENT DEVICES

FASTER TURNAROUND OF WORK PROGRAMMES, SIGNIFICANT REDUCTION OF CARBON FOOTPRINT, AND IMPROVED HEALTH AND SAFETY

Whilst the primary focus for the LiDAR data is vegetation another benefit identified is the depth of the point cloud being captured. This is primarily due to the slow speed and low height of the aircraft. The LiDAR data can be and has been used for network design, refurbishment or line profiling and has many other applications under development.

WPD has developed a relationship with and are working closely with Fugro to continually review innovative processes, thus ensuring that the LiDAR data is used to the maximum of its capabilities.

The combination of 3D visualisation, data analytics and photographic imagery that is all provided by the LiDAR system in combination with Fugro has had a significant impact on WPD's ability to develop knowledge of what vegetation is on or around the network.

Whilst specific measurements are used for internal processes, these default values can be changed to suit any requirement.

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We are delighted to be chosen for this innovative and cutting-edge project, which is the first time that a UK network operator has completely digitised their vegetation inspection workflow.

Working closely with WPD we implemented our award-winning Fugro ROAMES virtual world asset management solution and customised it to WPD's requirements to provide an advanced 3D visualisation tool (ROAMES World) that allows WPD's vegetation inspection teams to view the point cloud data, individual vegetation encroachments down to a span level, and the oblique camera images.

Peter Menting,
Manager Power Europe,
Fugro

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Fugro is pleased to play a part in this remote sensing effort.

The next stage will be full integration between the analytics in ROAMES and WPD's corporate systems to further accelerate delivery and we look forward to finding even more benefit for WPD in the future.

Peter Menting,
Manager Power Europe,
Fugro

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ROAMES World is supported by in-depth analytics streamed via Fugro's ROAMES Analytics product to provide WPD with information on distance, length, height, and volume of vegetation within the network and assigns any encroachments to individual spans without the need for onsite inspection.

The benefits of this digital inspection service include faster turnaround of work programmes, significant reduction of carbon footprint, and improved health and safety with WPD's inspectors able to undertake inspections remotely from the office.

ROAMES World and ROAMES Analytics are fully web-based so there is no need for additional applications or software to be installed on corporate systems. All of the 'onboard' systems are integrated into a mission rack mounted in the rear of the aircraft. The rack contains multiple computers for control of the equipment, image processing, video recording and data storage.

Storage is particularly important as on a normal day when combining the LiDAR data, stills imagery and any defect imagery captured it is standard to generate in excess of 85 gigabytes of data per hour per aircraft.





The computers and mission kit within the rack are controlled using the mission management system which is located in the rear passenger cabin of the aircraft and operated by the system specialist. Both the rack and mission management console were designed by Babcock.

The information from the cameras, LiDAR and AIMS is presented to both the observer (front seat) and the mission specialist (rear cabin) on touch screen Avalex monitors which are designed specifically for the Helicopter Unit's use.

Each individual screen is able to display multiple video channels and computer inputs allowing the operator to monitor various sensors at any one time that can be customised in real-time dependent on the type of inspection. This allows a defect to be displayed and analysed in the visual and non-visual spectrums in real-time at the same time.

The benefits of installing a front Avalex screen are twofold. Initially the observer can review the information obtained by the mission specialist and confirm that what is being captured is what is needed. Additionally the laptop system running the bespoke defect capture software is now displayed on the Avalex screen rather than a knee-mounted computer.

This has allowed the observer to maintain an eyes out perspective with minimal head movement. If and when required, through design, it is also possible to run and control some of the primary onboard systems from the front seat negating the need to carry a mission specialist on certain 'low workload' sorties.



All of the results from the inspections are reported back to WPD's control rooms and local offices in near real-time using the defect capture software known as EMU Air II. Any significant defects identified on the patrol that are either safety or reliability orientated can be captured and sent to Control directly from the aircraft using built in Wi-Fi and mobile technology.

As previously mentioned, the Observer uses the bespoke computer programme EMU Air to capture any defects identified on a patrol.

Originally, EMU Air was designed to replace paper mapping which was used to annotate defects identified while inspecting the overhead network. During its years in operation, the system's software has been updated and tweaked to create a unique mapping and defect capture system.

The 2021 re-write of the programme updated and improved its existing features and introduced significant new capabilities to produce a ground breaking piece of defect capture and asset condition recording software.

EMU Air II is configurable for most inspections, particularly within the utility industry. It can generate a list of defects for any asset, use any mapping for any area and produce any output in any format with very little effort.

When used in combination with CarteNav, the association and situational awareness between front seat Observer and rear seat System Operator is considerably enhanced which in turn assures the accuracy, output and results, which are required to maintain network resilience.





By introducing these new technologies along with their integration into one system and then attaching them to the existing fleet of aircraft the capability to provide near real-time data to WPD Network Services has expanded significantly. This innovative approach has developed into a one of a kind package which delivers a unique product, all on a flight which was being conducted anyway.

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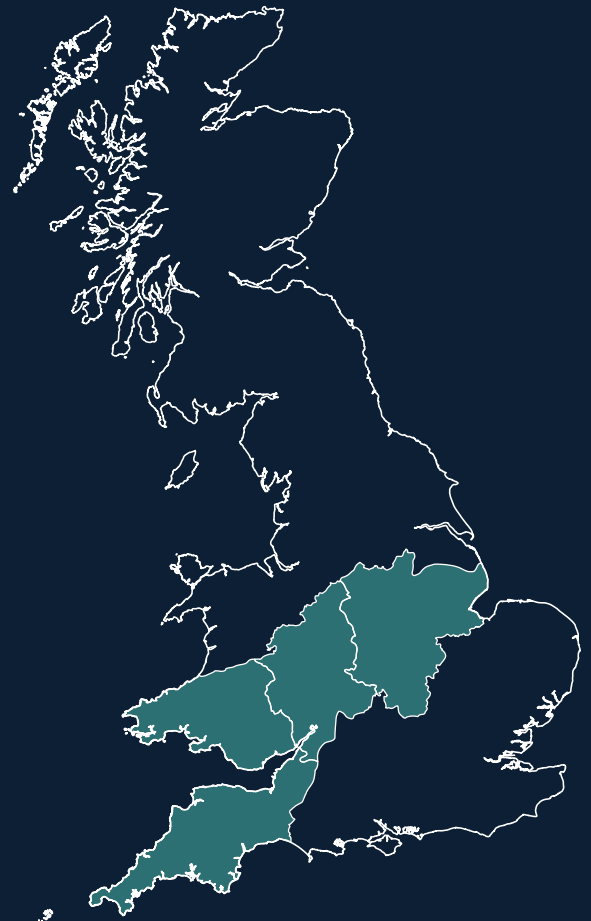
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