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Operation & Maintenance

About SOLUTE

SOLUTE is a multidisciplinary technical engineering consultancy with over 15 years of experience, headquartered in Madrid, with branches in Barcelona, Badajoz, and Toledo.

Throughout our history, we have primarily specialized in the renewable energy sector, particularly in the wind industry, where our capabilities cover all phases of wind farm development. Other sectors in which we specialize include automotive, solar energy, software development, weather forecasting services, and virtual reality, among others. This, along with the development of projects in more than 20 countries and for some of the most important clients in the sectors in which we operate, endorses us as one of the leading engineering consultancies in our country.

Our mission is to provide multidisciplinary solutions on a global scale, through the technical rigor and expertise of our engineers, ensuring the quality and excellence of our work in every project.

We highlight R&D&I as one of the main drivers of SOLUTE, as since the company's inception, we have launched several in-house developed tools, which are now offered as products to our clients. Some of these are Furow, a comprehensive wind resource software; Aphelion, a platform for weather and energy forecasting services applied to the wind sector; and EVE, our suite of virtualization services in industrial environments.

We believe that the best solutions are achieved as a team.

Operation & Maintenance Engineering (O&M)

Definition of the operation and maintenance task strategies, that are not only oriented to support the production conditions, but also focused on the service and lifetime extension besides the 20 years covered by the initial design certification.

Failure analysis

Audit services in order to **determine the root cause analysis (RCA),** both for structural elements (blades, hubs, frames, towers, etc.) and rotor and drive-train elements (blades bearing, main axis bearing, multiplier, yaw system, pitch system, etc.).

Determination and study of the **failure mechanisms**, as well as the **proposal of redesigns** or interventions in order to avoid or reduce similar errors in the future or even to mitigate assembly and/or design deficiencies.

Collection and study of the available information for the analysis:

- Inspection reports

- Historical repairing reports

- SCADA data and warnings

- Field actuations and access to the turbine

- Extraction of samples in order to carry out both destructive and non-destructive tests in accredited laboratories, with the purpose of defining the mechanical properties and thermal treatments

Installation of sensors (strain gauges, temperature, accelerometers, tachometers, etc.)

Historical data study and analysis: anomalies detection, recreation of the functioning conditions during failure.

Big data processing and analysis for its structuring, filtering, and establishment of correct functioning patterns.

Leadership, team and interventions management

Design of **integral plans** for solutions and preventable actions

Programming of **components inspection tasks**, coordinating workers into multidisciplinary teams

Evaluation of procedures, definition of new tasks and methodologies for its application

Definition of campaigns and development of destructive and non-destructive tests programs in coordination with specialized laboratories for **material characterization**

Coordination and management of **maintenance activities**

Equipment installation and data tracking

Meteorological data measurement, collection and transferring through the installation of different specific hardware devices.

Installation of strain gauges and data management

Monitoring strategies definition in order to evaluate the components' detected defects and its time progression during production.

Design of data collecting plans and massive transfer of all kinds of data

Development of a **self-designed SCADA system** for old wind energy devices with insufficient data

IOT system development

Processing and real time graphic representation of the collected data.

Generation of wind farm **control panels** that allow remote control of several mechanic components.

Design and repair proposals

Application of the transverse knowledge over the components mechanical-structural behavior in order to observe and analyze their service lifetime through the collected data interpretation and analysis. This knowledge has been acquired throughout our experience in the development and certification field.

Determination of the root cause of structural failures by means of finite elements models (FEM), that have been supplied with the collected data, as well as other analytics.

FEM modelling of the repair for the detail analysis of its behavior.

Procedures' evaluation

Evaluation and review of the assets' inspection and maintenance procedures.

Proposals for the execution time optimization and the data-taking quality improvement, including the integration of new measurement digital technologies.

High Voltage electrical support

- Design and maintenance review of substations and wiring.

- RCA breakage in transformers, converters, connectors, among others.

- Electrical protections and safety analysis.

Wind Farm Electrical support

- Audit costs and components unavailability.

- RCA of electrical components.

- Proposals to improve logistics and procedures.

- Tests and components coordination and evaluation.

Mechanical-structural support:

- RCA of components (blade, hub and spinner, racks, nacelles, tower, and joints).

- Tests coordination and evaluation.

- Design analysis and corrective modifications proposals.

- Evaluation and development of procedures for repairs and maintenances.

- Data processing inspections.

- Detailed structural-mechanical studies (FEM). Loads for redesign studies.

Rotating equipment mechanical support:

- RCA of components (gearbox, main bearing, pitch and yaw system, lubricants).

- Statistical failure analysis.

- Tests coordination and evaluation.

- Vibration analysis.

- Design modifications proposal and repair and maintenance procedures

Monitoring systems:

- Full asset sensorization

- Sensor data evaluation and damage diagnosing

- Machine Learning for predictive maintenance

- Alarm analysis and implementation

Operative reliability support

- Development and optimization of DDBB for operational data

- Business intelligence

- Software development for monitoring of assets and farm control

Civil Works support

- Tower and foundation design review

- RCA: pathologies in foundations and geotechnics

- Peer review and repairing solutions design

- Life extension analysis

Technical Due Diligence for farms in operation

Asset inspection:

- Detailed inspection of turbine components under non-destructive techniques

- SCADA and alarm historical data review

- Damage and risk evaluation

Systems and protocols evaluation:

- Control system

- Electric System

- Safety protocols review under required legislations

- Equipment: maintenance and safety

Real performance evaluation:

- Historical power production vs expected production

- Performance of each turbine vs design performance

- Asset availability (maintenance, emergency shut downs, unexpected damages,...)

O&M Plan review:

- Historical data evaluation from inspections, maintenance and repairing tasks.

- Analysis of fidelity in the follow-up of protocols

- Logistics plan review and replacement components availability

Our products

Our mission is delivering solutions on a global, multidisciplinary level through our technical rigor and our engineers´ knowledge, with R&D as our backbone.

The result of more than 15 years listening to different stakeholders´ problems is the development of products for the renewable energy industry, in the shape of software, hardware and services.
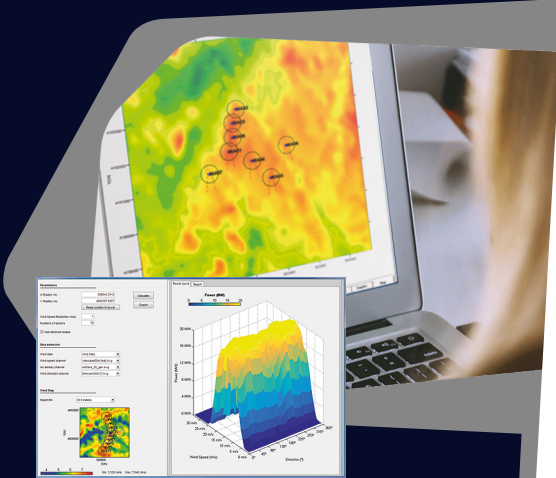
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furow~

WRA and Wind farm design software

Furow is a complete and exhaustive wind energy software, which possesses features directly with wind resource assessment calculations, wind farm modelling and project development at any given stage. Furthermore, its compatibility is flexible while working with other software, therefore, allowing users easy access to share and compare information

- Data analysis
- Wind resource assessment calculation (lineal model &CFD)
- Micrositing

aphelion

Multi-function weather and energy forecast software

Our meteorologists, data scientists, and software engineers are specialized in tools optimization in order to obtain the most accurate forecast for a wide variety of projects and clients.

From a high-resolution forecast, Aphelion offers meteorological and energy forecast as well as climate consultancy within a two-weeks' time horizon. Moreover, these capacities can be useful for both companydriven and particular-driven services.

Hybrid forecast model + Machine Learning

- ▶ Up to four multi-view maps with different models and variables
- ▶ Extensive range weather forecast (up to 16 days)
- ▶ Short-term weather forecast (0-72 hours)
- ▶ Four daily forecast updates and detailed meteograms

Aphelion Wind

- ▶ Automatic software with +5 machine learning architectures and ad-hoc features
- ▶ Wind farm and wind turbine forecast
- ▶ Customizable forecast ranges, updates, granularity, and time resolution
- ▶ ML models can calculate uncertainty estimations for production assessment scenarios (p90, p10, among others)

EVE

Enhanced Virtual Environments

Virtualization and digitalization services for industrial sectors

- High detail 3D laser scanning
- Virtual tours with embedded technical information
- Maintenance tasks digitalized in tablet device for field guidance
- VR platform for operation and emergency instruction
- Multi device and multiplayer options

EOLIAN

Predictive maintenance plaftorm for renewable farms

Deep Learning on the Edge and IA algorithms combined for an optimization of the maintenance interventions in renewable energy farms

- Asset sensorization and monitoring
- Remote cloud monitoring
- Predictive maintenance IA algorithms
- Big data techniques for traceability, accessibility and analysis
- Real-time processed on edge data uploaded to servers (IoT+edge computing)

TSRWIND

Comprehensive wind turbine inspection

TSR Inspector

TSR Wind customers' cloud software platform for inspection data processing and management.

EOLOS

External blade inspection robot with high resolution photo camera, capable of climbing any metal surface by permanent magnets

CERBERUS

Remote inspection of blade interiors by small mobile robot with 3 high resolution video cameras to access impossible places for technicians.

KRATOS

Bidirectional magnetic coupling robot designed to climb any metal surface and follow the welding cords using an NDT ultrasound equipment

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