Operación de plantas desde el Centro de Control

Cómo mejorar la eficiencia gracias a la automatización

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Company overview

Unlimited Power for Wind Farms and Solar Plants

- 9+ Years experience in the sector
- 10+ countries where we provide services
- 20+ OEM Scada’s we are working with
- 250+ plants where CompactSCADA is running
- 6+ GW total monitored installed power
The context

Wind energy sector trends

Levelized Cost of Electricity (LCOE)
- 5th Percentile
- Average
- 95th Percentile

Capacity Factor (%)
- 5th Percentile
- Average
- 95th Percentile

Total Installed Cost
- 5th Percentile
- Average
- 95th Percentile

USD/kWh
- 2010: 0.086
- 2012: 0.083
- 2014: 0.082
- 2016: 0.076
- 2018: 0.069
- 2020: 0.064

USD/kW
- 2010: 27,00%
- 2012: 28,50%
- 2014: 30,60%
- 2016: 34,00%
- 2018: 35,60%
- 2020: 35,60%

USD/kW
- 2010: 1049
- 2012: 1049
- 2014: 1972
- 2016: 1939
- 2018: 1781
- 2020: 1635

USD/kW
- 2010: 1549
- 2012: 1473
- 2014: 1473
- 2016: 1473
- 2018: 1473
- 2020: 1473
The context

Heterogeneous wind technology portfolios

Installed Power (GW)

WTG Age by 2020

WTG Age by 2025
The context

O&M business adjustment

Full-service O&M pricing

Country: Denmark, Full-Service Renewal Contracts, Germany, Initial Full-Service Contracts, Ireland, Norway, Sweden, United States of America

USD/kW/year


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Spanish Wind Energy Association
The context

Wind energy sector trends
# Automation vs. Standard Operations

<table>
<thead>
<tr>
<th></th>
<th>Fast (5 seconds)</th>
<th>Standard (20 minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average response time:</strong></td>
<td>Fast (5 seconds)</td>
<td>Standard (20 minutes)</td>
</tr>
<tr>
<td><strong>Strategies:</strong></td>
<td>10 (Remote RESET, Wind Sector Management, Flickering, Noise Reduction, Market Price, Bats, Birds, Safe Stops, Cost, Weather alerts, Life Time extension)</td>
<td>1 (Remote RESET)</td>
</tr>
<tr>
<td><strong># of Protocols:</strong></td>
<td>10 per individual turbine</td>
<td>1-2 per site</td>
</tr>
<tr>
<td><strong>Safety of assets:</strong></td>
<td>High</td>
<td>Standard (due to human errors and unattended assets)</td>
</tr>
<tr>
<td><strong># of turbine operated:</strong></td>
<td>~ 5 000 per operator (x5 times capacity)</td>
<td>~ 1 000 per operator</td>
</tr>
</tbody>
</table>
Operational challenges of large portfolios

There are many opportunities to increase efficiency and safety by adapting operations processes, moving from human-based to automation-based control.

1. Scalability: Optimize manpower
   - Avoid repetitive tasks and get people to focus on customer added value activities such as performance analysis or operations support center.

2. Quicker and more intelligent response time
   - Improve operational processes using all available data and historical operations knowledge.

3. Increase assets’ safety by performing automated preventive actions
   - Based on WTG/Components and environmental conditions.

4. Implement Strategies beyond human capabilities
   - Adapted to environmental restrictions or energy market prices or commercial strategies.
Operational challenges of large portfolios

There are many opportunities to increase efficiency and safety by adapting operations processes, moving from human-based to automation-based control.

Scalability: Optimize manpower

Avoid repetitive tasks and get people to focus on customer added value activities such as performance analysis or operations support center.
Operational challenges of large portfolios

Manpower optimization

48 Hours Analysis - High ROC Overload with just 1 Wind Farm (59 WTGs)

- Notifications
- RESETS
- Average of Wind Speed (m/s)

Average of Wind Speed (m/s)

175 Notifications
256 RESETS
19.95 Wind Speed (m/s)
Operational challenges of large portfolios

There are many opportunities to increase efficiency and safety by adapting operations processes, moving from human-based to automation-based control.

Quicker and more intelligent response time

Improve operational processes using all available data and historical operations knowledge.
Operational challenges of large portfolios

Quicker and more intelligent response time

**Successfull RESETS vs Load Factor Distribution**

- 4224 RESETS
- 3543 SUCCESSFULL RESETS
- 83.88% SUCCESSFULL
- 40.23% Load Factor
- 15.24 Wind Speed (m/s)
Operational challenges of large portfolios

Quicker and more intelligent response time

Automatic Notifications vs Load Factor Distribution

- # Notifications
- Theoretical Power Curve (kW)

- 2557 Notifications
- 30.27% Load Factor
- 15.73 Wind Speed (m/s)
- 852.33 MAN HOURS (hours)
Operational challenges of large portfolios

There are many opportunities to increase efficiency and safety by adapting operations processes, moving from human-based to automation-based control.

Increase assets’ safety by performing automated preventive actions

Based on WTG/Components and environmental conditions
Operational challenges of large portfolios

Automation provides security and flexibility

Checks on:

Wind Turbine Status

+ Communications.
+ Working Schedule.
+ On-field technicians availability.
+ Major components quarantine periods.
Operational challenges of large portfolios

There are many opportunities to increase efficiency and safety by adapting operations processes, moving from human-based to automation-based control.

Implement Strategies beyond human capabilities

Adapted to environmental restrictions or energy market prices or commercial strategies
The operational challenges of large portfolios

Implement Strategies beyond human capabilities:

WTG Status & Health:
- Wind Speed
- Wind Direction
- Active Power
- Active primary and secondary alarms
- Main component status

External inputs
- Weather forecast
- Energy forecast
- Energy market price
- Environmental restrictions
Business case

Automated Renewable Smart Operations Software

Initial Situation
- 470 WTGs
- 500 MW
- 5 People
- Full Capacity

Need
- x2 Portfolio size
- 1 GW
- ? People

ARSOS Pilot
- 56 WTGs
- auto-pilot
- Automatic Operations

Expansion
- 750 WTGs
- 1 GW
- All fleet
- Spain & Italy

2 wind farms pilot
- sep 2020

Spain fleet
- oct 2020
- nov 2020
- dic 2020
- ene 2021

whole Fleet
- feb 2021
Scalability Increase

Man hours saved thanks to automated actions

2.4 people saved (1 year)

x2 ROC capacity

2557 AVISOS
4224 RESETS
2.260.33 MAN HOURS
Availability Increase

ARSOS reduces time response from 20 minutes to near 0

+1% time-based availability /year
# Business SUCCESS case

RWE Control Center in Barcelona

<table>
<thead>
<tr>
<th>Initial Situation</th>
<th>Need</th>
<th>ARSOS Pilot</th>
<th>Expansion</th>
</tr>
</thead>
<tbody>
<tr>
<td>470 WTGs</td>
<td>x2 Portfolio size</td>
<td>56 WTGs</td>
<td>750 WTGs</td>
</tr>
<tr>
<td>500 MW</td>
<td>1 GW</td>
<td>auto-pilot</td>
<td>1 GW</td>
</tr>
<tr>
<td>5 People</td>
<td>? People</td>
<td>Automatic Operations</td>
<td>All fleet</td>
</tr>
<tr>
<td>Full Capacity</td>
<td></td>
<td></td>
<td>Spain &amp; Italy</td>
</tr>
</tbody>
</table>

**Savings**

- 240k€ Savings due to Manpower Optimization
- 192k€ Increase of Availability and Production
- 150k€ Reduction of Maintenance Costs

**Total Savings**

- 582k€/y
The solution: ARSOS

Automated Renewable Smart Operations Software

**INTELLIGENT CONTROL**
Turn data into action. Automate your ROC operations

**INTEGRATED ANALYTICS**
Dispose of real quality data and gain full analytical autonomy

**INTEGRAL MONITORING**
Universal and reliable data gathering platform
### Last actions done

**ARSO activity log**

<table>
<thead>
<tr>
<th>WTG</th>
<th>Site</th>
<th>Action done</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>JP03</td>
<td>Jupiter</td>
<td>RESET: Executed 1/3 attempt</td>
<td>3 min. ago</td>
</tr>
<tr>
<td>JP13</td>
<td>Jupiter</td>
<td>Changed to human mode</td>
<td>30 min. ago</td>
</tr>
<tr>
<td>JU16</td>
<td>Juno</td>
<td>RESET: Executed 1/2 attempt</td>
<td>45 min. ago</td>
</tr>
<tr>
<td>JP11</td>
<td>Jupiter</td>
<td>Maintenance mode detected</td>
<td>1 hr. ago</td>
</tr>
<tr>
<td>BA12</td>
<td>Bosque Alto</td>
<td>Maintenance mode detected</td>
<td>2 hr. ago</td>
</tr>
<tr>
<td>BA21</td>
<td>Bosque Alto</td>
<td>Maintenance mode detected</td>
<td>2.5 hr. ago</td>
</tr>
<tr>
<td>JP11</td>
<td>Jupiter</td>
<td>RESET: Executed 1/2 attempt</td>
<td>3 hr. ago</td>
</tr>
<tr>
<td>JU12</td>
<td>Juno</td>
<td>Maintenance mode detected</td>
<td>4.5 hr. ago</td>
</tr>
<tr>
<td>JU13</td>
<td>Juno</td>
<td>Maintenance mode detected</td>
<td>5 hr. ago</td>
</tr>
<tr>
<td>JU14</td>
<td>Site</td>
<td>Maintenance mode detected</td>
<td>6 hr. ago</td>
</tr>
</tbody>
</table>

### ARSOS Upcoming Actions

The following table shows the scheduled automated actions:

<table>
<thead>
<tr>
<th>WTG</th>
<th>Site</th>
<th>Automated control</th>
<th>Remaining time</th>
<th>Manual Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>JP11</td>
<td>Jupiter</td>
<td>NOTIFY: No more Remote BST allowed. Sending notification to on-site technicians</td>
<td>00:00:30</td>
<td></td>
</tr>
<tr>
<td>JP03</td>
<td>Jupiter</td>
<td>RESET: Executing 2/3 attempt</td>
<td>00:07:00</td>
<td></td>
</tr>
<tr>
<td>JU13</td>
<td>Juno</td>
<td>STOP: due to Vibration, low production forecast and low energy price</td>
<td>00:22:00</td>
<td></td>
</tr>
<tr>
<td>JP12</td>
<td>Jupiter</td>
<td>RESET: Executing 2/3 attempts</td>
<td>00:50:00</td>
<td></td>
</tr>
</tbody>
</table>

### ARSOS WTG Overview

#### Jupiter

<table>
<thead>
<tr>
<th>WTG</th>
<th>Status</th>
<th>Power</th>
<th>Wind Speed</th>
<th>OEM Status</th>
<th>Pitch Angle</th>
<th>Smart Control Scenario</th>
<th>Next Actions</th>
<th>GU Operations</th>
<th>Manual Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>JP01</td>
<td>CARTED</td>
<td>Poor</td>
<td>19.8</td>
<td>PRO</td>
<td>-0.1</td>
<td>--</td>
<td>--</td>
<td>MADE_AE16_ALS</td>
<td></td>
</tr>
<tr>
<td>JP02</td>
<td>CARTED</td>
<td>Poor</td>
<td>22.2</td>
<td>PRO</td>
<td>0</td>
<td>--</td>
<td>--</td>
<td>MADE_AE15_ALS</td>
<td></td>
</tr>
<tr>
<td>JP03</td>
<td>FAULT</td>
<td>Poor</td>
<td>23.0</td>
<td>PAR</td>
<td>87</td>
<td>--</td>
<td>--</td>
<td>MADE_AE14_ALS</td>
<td></td>
</tr>
<tr>
<td>JP11</td>
<td>FAULT</td>
<td>Poor</td>
<td>24.2</td>
<td>PAR</td>
<td>87</td>
<td>--</td>
<td>--</td>
<td>MADE_AE14_ALS</td>
<td></td>
</tr>
<tr>
<td>JP12</td>
<td>FAULT</td>
<td>Poor</td>
<td>22.9</td>
<td>PAR</td>
<td>87</td>
<td>--</td>
<td>--</td>
<td>MADE_AE15_ALS</td>
<td></td>
</tr>
<tr>
<td>JP13</td>
<td>FAULT</td>
<td>Poor</td>
<td>22.4</td>
<td>PAR</td>
<td>87.1</td>
<td><strong>error:107-Termite Interface 112225 sec.</strong></td>
<td>--</td>
<td>MADE_AE16_ALS</td>
<td></td>
</tr>
</tbody>
</table>

**JP13 FAULT**

#### Bosque Alto

<table>
<thead>
<tr>
<th>WTG</th>
<th>Status</th>
<th>Power</th>
<th>Wind Speed</th>
<th>OEM Status</th>
<th>Pitch Angle</th>
<th>Smart Control Scenario</th>
<th>Next Actions</th>
<th>GU Operations</th>
<th>Manual Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>BA12</td>
<td>STOPPED</td>
<td>Service</td>
<td>8.9</td>
<td>8</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>MADE_LPP_GR_S</td>
<td></td>
</tr>
<tr>
<td>BA21</td>
<td>STOPPED</td>
<td>Service</td>
<td>4.7</td>
<td>8</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>MADE_LPP_GR_S</td>
<td></td>
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