INDICATIVE PROPOSAL FOR SUPPLY, DELIVERY, INSTALLATION AND MAINTANANCE OF BIOSECO BIRD PROTECTION SYSTEM

May, 15th, 2023

Background

This offer was prepared by Bioseco following Request for Proposal (RFQ) sent by RWE Renewables Italia SRL further "Client".

The Client is planning to operate wind farm "SAN SEVERO" located in Apulia region, Italy, where 12 WTG shall be equipped with bird protection system within 4Q2024.

Details:

Number of turbines: 12 WTG
Type of turbine: SG145-4,5MW
Hub height at 127,5m
Rotor diameter: 145 m

Bioseco offers to Client to install its Bird Protection System "BPS" in the project on indicated wind turbines as a mitigation action reducing the risk of bird collision.

The offer contains the following items:

1. Description of the Bird Protection System
2. Products to be delivered
3. Scope of offer
4. Warranty
5. Time schedule
6. Commercial offer
7. Payment schedule
8. Resources to be allocated in the project
9. Bioseco requirements
10. Exclusions and limitations
11. Offer Validity
12. Appendices

1. Executive description of the Bioseco BPS

Bioseco developed unique hardware and software technology which is contained in its product called **Bird Protection System** ("BPS").
Bioseco has been developing the system since 2013 with the aim of protecting birds and **reducing unnecessary shutdown** time of the turbines.
In 2020 Bioseco developed special filtering algorithm, which is based **on Artificial Intelligence** which allows for bird size classification and lowering False Positive.

Main features of Bioseco BPS are:

1. **Stereovision** which enables **distance estimation** between the turbine and a bird in real time, which allows to stop the turbine only in case estimated **distance is lower** than agreed threshold (200m or 300m)
2. Deterrent system composed of **light and sound deterrents** (optional), which can be customised depending on operators need regarding noise levels,
3. **Online application** with web access allowing to review detections made by the system, estimated flight path and distance, pictures and movie from the detection and **activation of each of protection systems** (light deterrent, sound deterrent, turbine stop)
4. **Non-invasive installation** using mobile lifting platforms with use of special montage procedure and materials in order to avoid creating any damage to the wind turbine tower,
5. **Bird classification** by size (smaller/larger), which allows for activation of the turbine stop **only for certain sizes of birds** i.e. larger birds >1,2 m in wingspan (available in BPS Premium and Long Range),
6. Combination of stereovision with advanced filtering algorithms based on AI allow for **low false positive ratio**[1] (due to insects, planes, helicopters, clouds), reducing unnecessary turbine stops and loss of production (available in BPS Premium and Long Range),

- Bioseco installed over 100 systems in Poland, Germany, Spain and France.
- References are attached to this offer as **Appendix 5**

The idea of Bioseco is to offer **a one stop shop**, by which the wind farm operator can focus on its tasks as Bioseco limits as much as possible the assistance of the Project Owner, i.e. Bioseco requires in principle the assistance in getting inside the turbine to set up and service the data server and stopping the turbine for installation and maintenance works.
Bioseco will also require the assistance of turbine manufacturer and Client in order to establish connection between BPS and turbine Scada in order to activate the turbine stop. Bioseco does not require any other assistance from the operator to install or maintain BPS during normal operation, except in case of failure when access to the turbine and substation might be required.
Thanks to the fact that BPS is installed from mobile platforms there is **no need of rope** access from the nacelle for the installation or maintain the BPS.

The turbines manufactured by following supplier are equipped with Bioseco systems:

- Vestas, SGRE, Enercon, Acciona WP, Alstom, GE, Nordex.

[1] False positive ratio = false positive (non-bird) detection stopping the turbine/all detections

There are **3 versions of BPS (Standard Plus, Premium & Long Range)** that are on the market now.

Bird Protection System Standard Plus (6 modules)	**Bird Protection System Premium (8 modules)**	**Bird Protection System Long – range (8 modules)**
• Visual bird detection system covering 360 degrees around wind turbine • Two UHD cameras for each bird detection module coupled in stereovision mode • One UHD camera for video recording of detections per module • Distance estimation between the bird and the turbine • **Bird size classification smaller/larger than 1,2m wingspan** • Altitude estimation of the bird flight • Graphical flightpath estimation • Standard false positive detection filtering (False positives ratio <15%) • Data processing server equipped with CPU and 8 TB of data storage • Online access to web-application allowing for preview of bird detections and data (requires internet connection)	• Visual bird detection system covering 360 degrees around wind turbine • Two 4K cameras for each bird detection module coupled in stereovision mode supported by own mircoprocessing unit with CPU and GPU for each bird detection module coupled in stereovision mode • Distance estimation between the bird and the turbine • Altitude estimation of the bird flight Graphical flightpath estimation • **Bird size classification smaller/larger than 1,2m wingspan** • **Advanced filtering based on Artificial Intelligence allowing for low false positive detections ratio (<10%)** • Data processing server equipped with CPU and **Nvidia GPU** and 8 TB of data storage • Online access to webapplication allowing for preview of bird detections and data (requires internet connection)	• Visual bird detection system covering 360 degrees around wind turbine • Four 4K cameras supported by own mircoprocessing unit with CPU and GPU for each bird detection module coupled in stereovision mode • Extended detection distance as compared to Standard and Premium versions • Distance estimation between the bird and the turbine • Altitude estimation of the bird flight Graphical flightpath estimation • **Bird size classification smaller/larger than 1,2m wingspan** • **Advanced filtering based on Artificial Intelligence allowing for low false positive detections ratio (<10%)** • Data processing server equipped with CPU and **Nvidia GPU** and 16 TB of data storage • Online access to webapplication allowing for preview of bird detections and data (requires internet connection)

Technical specification of BPS Standard Plus, Premium and Long Range are enclosed as **Appendix 1-3**.

All versions differ in terms of detection efficiency at certain distances, which is summarised on next page:

Detection efficiency of BPS Standard Plus

Detection range

Bird wingspan[2]	**Detection range m (min/max[3]).**
0.7-1.2m	20-300’
1.2-1.6m	20-400’’
>1.7m	20-500’’’
‘1.2 m wingspan ‘’ 1.5 m wingspan ‘’’ 2m wingspan	

Estimated Detection efficiency[4]

Bird wingspan	**Cumulative** detection efficiency by d**istance category m**	<100m	<200m	<300m	<400m
0.7-1.2m	% detected	90%	75%	50%’	-
1.2-1.6m	% detected	90%	80%	60%’’	50%’’
>1.7m	% detected	90%	80%	80%	60%’’’
‘1.2 m wingspan ‘’ 1.5 m wingspan ‘’’ 2m wingspan					

Detection efficiency of BPS Premium

Estimated Detection efficiency[5]

Species	Wingspan	Detection distance (m) at min. 80% detection efficiency	Detection distance (m) at min. 50% detection efficiency	Maximum detection distance[m][6]
Accipiter nisus	0.7-0.8	<200	<250	300
Falco tinnunculus	0.7-0.8	<200	<250	300
Circus aeruginosus	1.0-1.3	<300	<350	400
Buteo buteo	1.1-1.4	<300	<350	400
Milvus milvus	1.4-1.6	<400	<450	500
Clanga pomarina	1.6-1.8	<500	<550	600
Haliaeetus albicilla	2.2-2.4	<600	<650	700

[2] Birds smaller than 0,6m (e.g. passerines) are automatically filtered out from detections.

[3] Assuming that bird flights into monitored area in directly toward the detection module and wings fully extended

[4] based on Aschwanden, J. & F. Liechti (2019): Test of the automatic bird detection system BPS on the test field of WindForS in the context of nature conservation research (NatForWINSENT). Schweizerische Vogelwarte, Sempach

[5] Based on observations during pilot project at Lotnisko Wind Farm, Poland, 04-10.2020

[6] Assuming that bird flights into monitored area in directly toward the detection module and wings fully extended

Detection efficiency of BPS Long Range

Estimated Detection efficiency

Species	Wingspan	Detection distance (m) at min. 80% detection efficiency	Maximum theoretical detection distance[m][7]
Accipiter nisus	0.7-0.8	<250	400
Falco tinnunculus	0.7-0.8	<250	400
Circus aeruginosus	1.0-1.3	<400	650
Buteo buteo	1.1-1.4	<400	650
Milvus milvus	1.4-1.6	<500	750
Clanga pomarina	1.6-1.8	<600	800
Haliaeetus albicilla	2.2-2.4	<750	1000

Project specific considerations:

Bioseco analyzed the Project layout provided in kmz file.
We have plotted various detection distances stemming from various BPS Versions.

The conclusions are as follows:

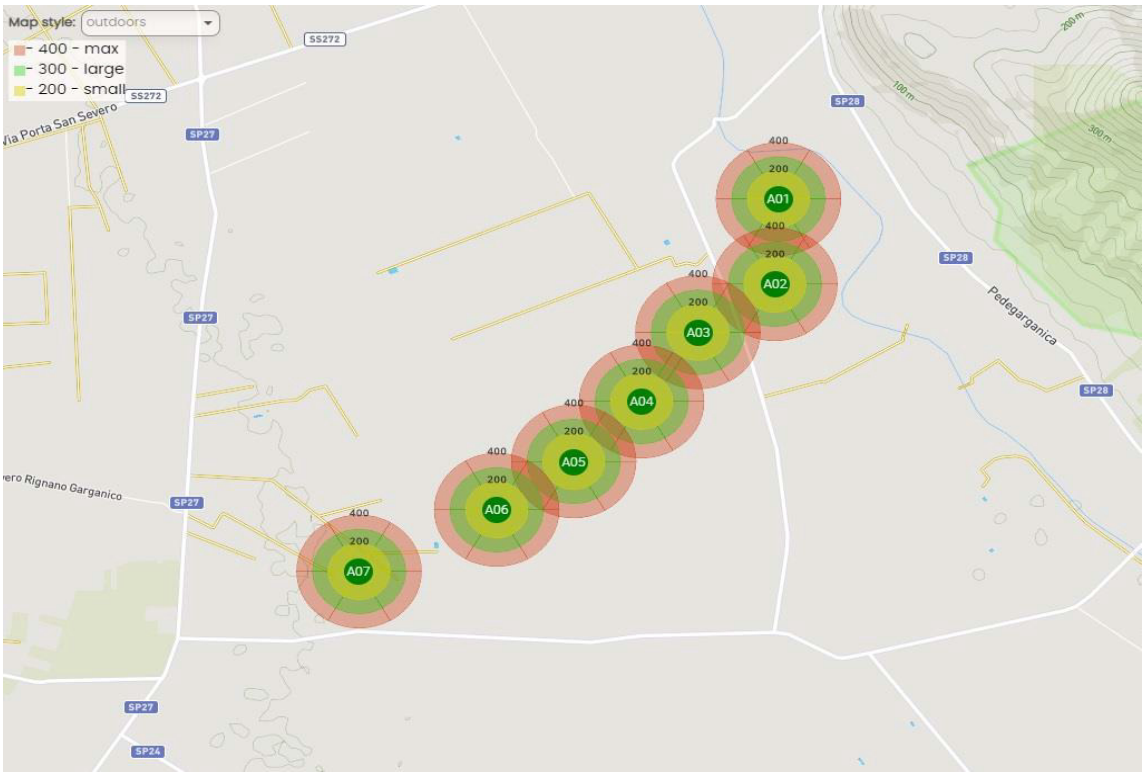
- **BPS Standard Plus seem on the limit of needed detection distances given the size of the rotor and BPS detection capabilities,**
- **BPS Premium offers good overall detection coverage for both small and large birds**
- **BPS Long range offers best detection coverage, in some cases enabling the management of 2 turbines by one BPS (master – slave approach)**
- **Bioseco does not recommend master – slave approach as it increases the risk for birds, decreases the efficiency of deterrents, besides BPS Long Range is almost double cost of BPS Premium so no real savings would be obtained**
- **Given the distances between turbines and size of turbines Bioseco recommends BPS Premium for the Project under the assumption that each turbine will be equipped with one dedicated BPS unit**

Below you can find the results in graphical form for both parts of the WF.

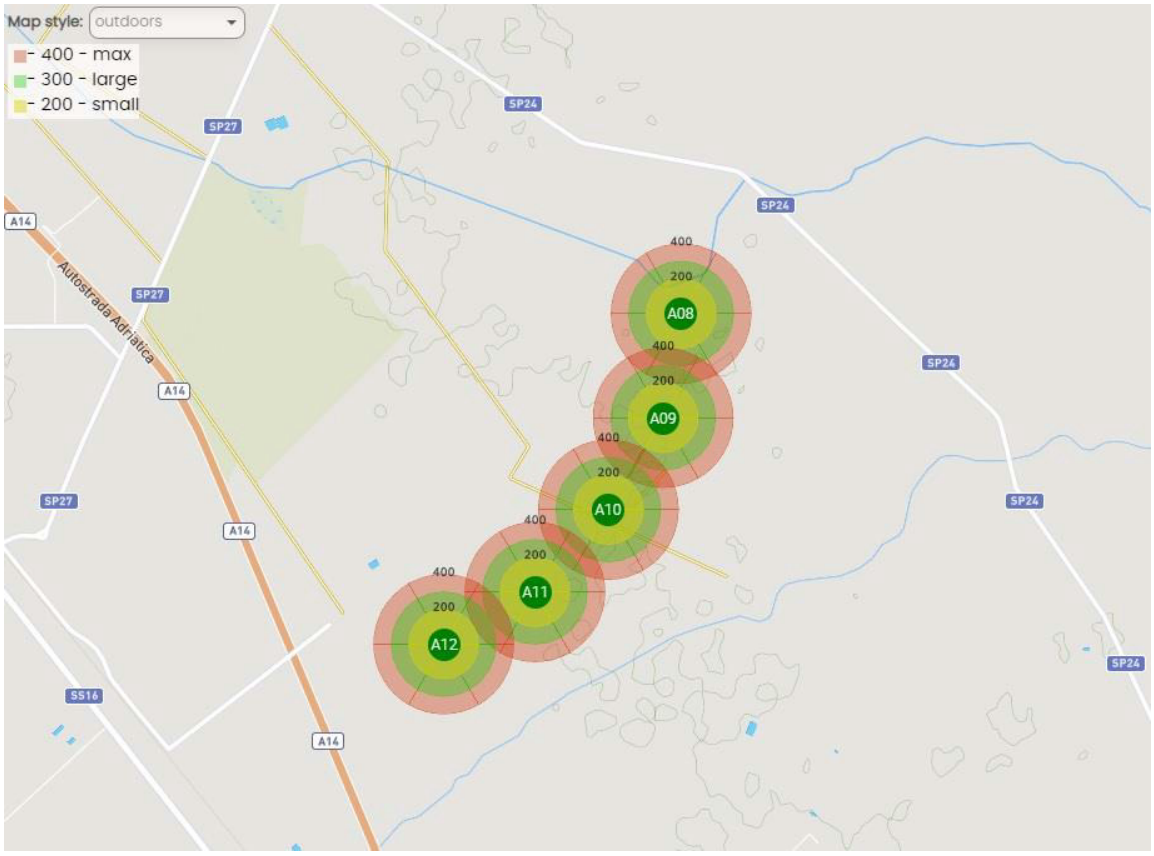
[7] Assuming that bird flights into monitored area in directly toward the detection module and wings fully extended

BPS Standard Plus

North

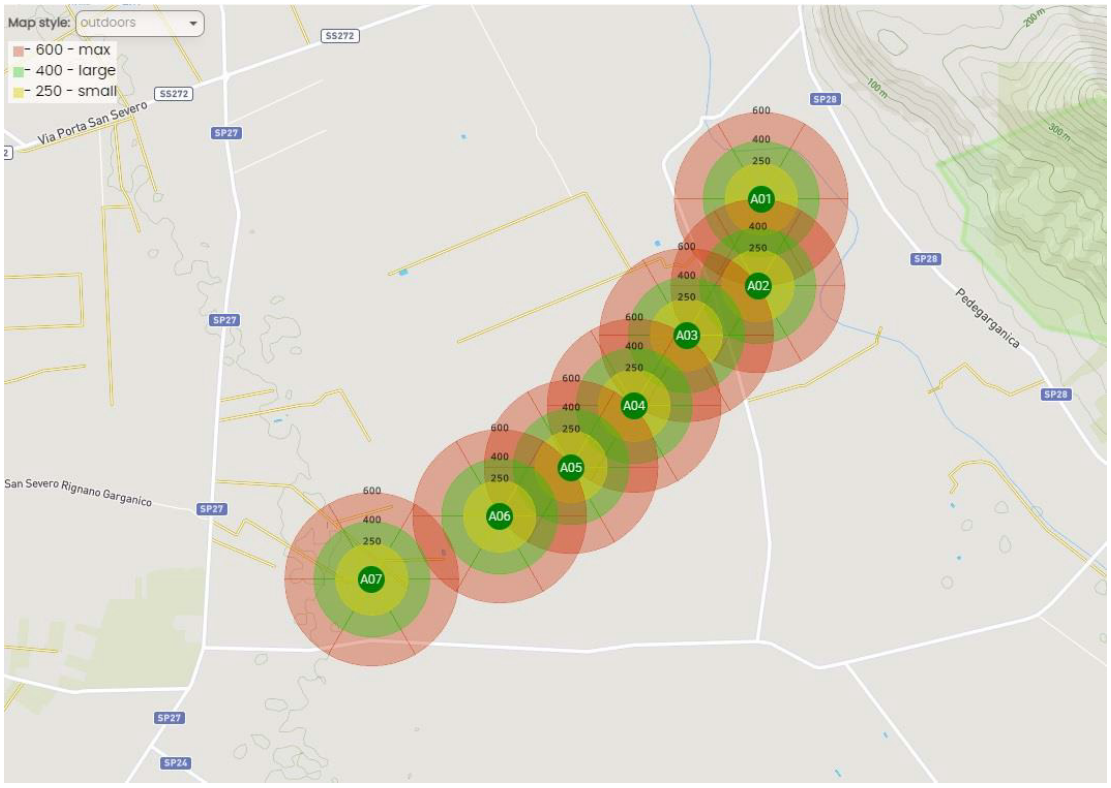


South

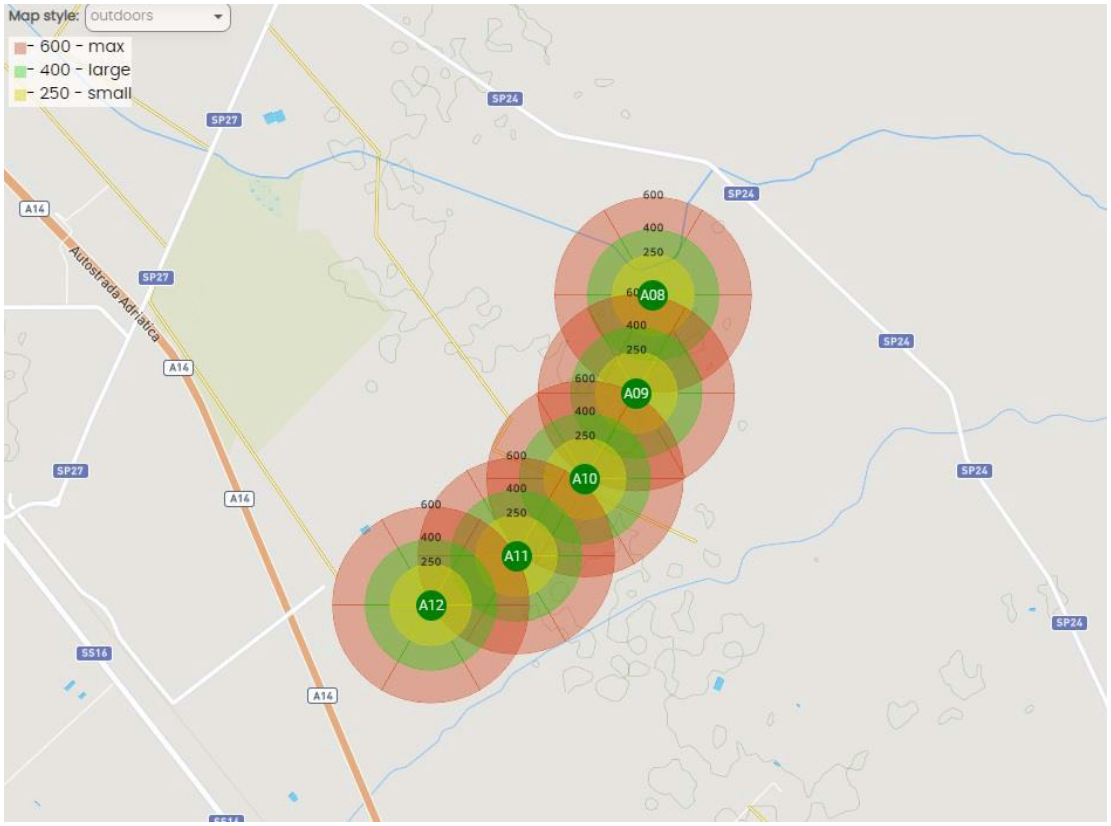


BPS Premium

North

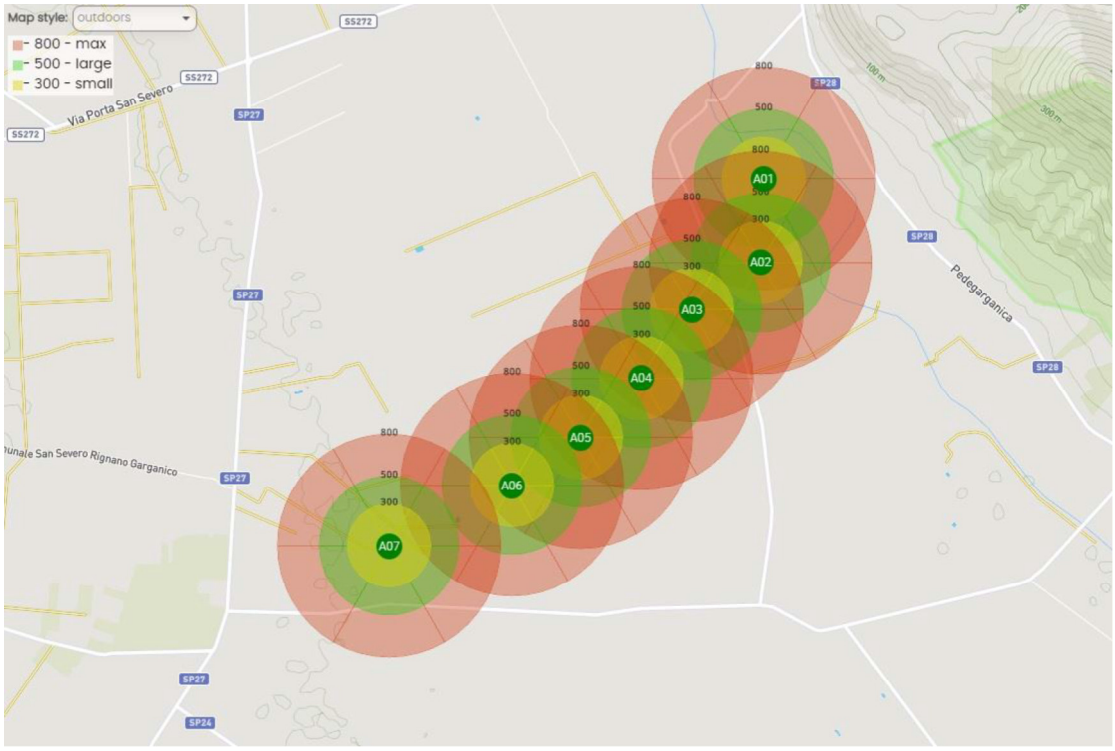


South

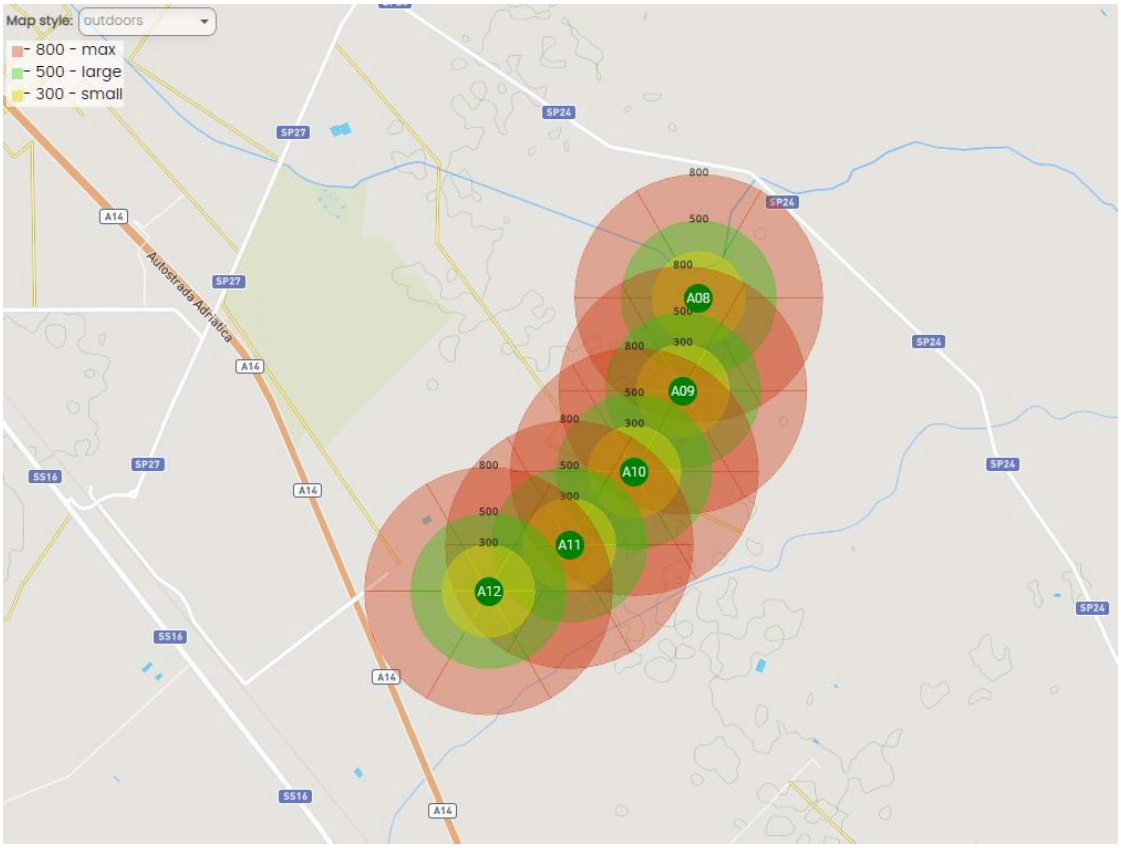


BPS Long Range

North



South



Given that bird protection systems are likely to operate throughout the lifetime of the wind farm we strongly recommend that the **Client takes into account two aspects:**

- **Bird size**
  From Bioseco experience on average 50-90% (depending on site) of all detections are caused by birds smaller than 1,2m in wingspan. The ability to estimate the size of detected bird and classify into small/large category is vital in assessing the bird protection system. Activation of the turbine stop only for bird larger might save a lot of unnecessary loss of production and turbine components fatigue.
  As the average activity of birds and size distribution at the wind farm in question is unknown to Bioseco the following exemplary calculation might be developed to present the scale of phenomenon:
  10 detections of small bird per day =10 detections * 365 days= 3650 unnecessary stops per year * 4 minutes turbine shutdown (typical stop time) = 3650*4 minutes = 14.600 minutes p.a. = **243,3 hours of unnecessary turbine shutdowns**.
  At average 1hour = 1 MWh of production and 60EUR/MWh that is an **annual loss of income of 243,3MWh * 60 EUR/MWh = 14.598 EUR/per turbine**
  Apart from loss of production due to turbine stop due to detection of small birds, numerous stops cause **additional fatigue of turbine components** and result in increased turbine maintenance costs.
- **False positive ratio**
  False positives ratio (FP) is one of critical parameters of bird protection systems. The wrong identification of object not being a bird and causing stopping the turbine will inevitably cause unnecessary shutdowns, reduction of operational time and loss of production.
  In order to better present the significance of this feature the following exemplary calculation was prepared dependent on various site activity (FP are usually benchmarked as % of all detections) and guaranteed by system provider level of False Positives.

Exemplary calculation of the impact of false positives level on loss of operating hours

ASSUMED SITE ACTIVITY	low	medium	high
bird detections per day	5	15	30
bird detections per year	1 825	5 475	10 950
annual turbine shutdown (min)	7 300	21 900	43 800
annual turbine shutdown (hours)	122	365	730

LOSS OF HOURS OF OPERATIONS DUE TO FALSE POSITIVES			
False positive level	low	medium	high
10%	12	37	73
20%	24	73	146
40%	49	146	292

At average 1hour = 1 MWh of production and 60EUR/MWh annual loss of income due to false positives might range **annually** from **720 EUR** (low activity, 10% FP) via **4.380 EUR** (medium activity, 20% FP) to even **17.520 EUR** (high activity, 40% FP).

Reducing the **level of false positives** to a very low level is possible thanks to the use of advanced algorithms based on artificial intelligence.

2. Products to be delivered

Regarding the Client requirements regarding detection efficiency, Bioseco decides to offer to the Client:

Twelve (12) Bioseco BPS - Version to be decided by Client *audio, strobe deterrents included while rotor monitoring system is quoted as an option*

3. Scope of offer

The offer includes the following activities:

1) **Supply of BPS inc. Manufacturing, Transport, Installation, Start-up, Calibration and Configuration of BPS**
   The scope includes hardware, materials, tools, rental of Lifting platforms), labour, travels, lodging, 2 year warranty and license to use Bioseco software for the purpose of Products operation
2) **Maintenance and service,**
   Annual maintenance & service inc. remote monitoring of system, remedy of failures, availability guarantee as an option (min. 2 years contract duration)
3) **Online services & reporting**
   Web access to Bioseco Client application including data storage & back-up for 1 year of data, automated quarterly reporting

4. Warranty

Bioseco grants 2 years warranty period for its Products during which Bioseco shall be responsible for the reparation or replacement of any equipment broken in a normal use including shipment and installation cost. Warranty is valid only if there is a maintenance contract in place.

Warranty excludes any failure or damage caused by third persons or buyers employees/contractors or environmental conditions outside the technical specification including falling ice.

5. Time schedule

The general time schedule looks as follows (counted from receipt of advance payment).

1. ORDERING AND COLLECTION OF COMPONENTS - 10 weeks
2. ASSEMBLY PHASE - 12 weeks (1 week per BPS)
3. TRANSPORTATION PHASE – 2 weeks – shipment to Site
4. INSTALLATION PHASE – 1 working days per BPS – installation of Product
5. CALIBRATION PHASE – 1-2 weeks – configuration and calibration
6. TAKE OVER - 1 day – take - over of the equipment
7. SITE VISIT – ca. 2 - 4 weeks before planned installation

Final time schedule will be confirmed by Bioseco once advance payment is received from the Client and all components have been ordered.
Expected supply and installation 3/4Q2024.

9. Bioseco requirements from the Client:

- Access to turbines, both outside and inside to install BPS hardware (server and connection cables), including a hole (2cm diameter) to enter the turbine interior around the turbine door (details to be agreed)
- Provision of area in the turbine tower to place server rack cabinet (dimensions in technical specs.),
- Stopping the turbine during installation and maintenance of BPS (max. 10h for installation of the turbine per BPS, maintenance stop depending on failure nature),
- Provision of power supply 220-230V in the tower of turbine for BPS operation,
- Provision Broadband Internet connection shall be secured by the Client (LTE available on site - 5 Mbs symmetrical broadband connection minimum, preferably 10+ Mb/sec Simcard to be provided and cost to be borne by the Client; For Premium System with Rotor Monitoring ca. 100-200 Gb per system/month. Without rotor monitoring up to 50Gb/month),
- If BPS is to be interconnected by an optical fiber to local ethernet any converters or an optical fiber equipment necessary is outside the scope of the offer and shall be provided by the Client,
- In case of WTG stop module – establishing a connection with WTG Scada allowing to Stop the turbine based on signal from BPS shall be arranged by the Client, details to be agreed between Bioseco and Turbine Manufacturer with Client's assistance/support
- Bioseco will need 2 mobile lifting platforms with height depending on the proposed system installation height to be decided at site visit (usually up to 20m). The rent out of platforms is included in this offer. Client shall assist in arranging platforms.
- Bioseco will ship the equipment by courier, hence the Client shall secure a dry storage place in a locked warehouse close to the Wind Farm of 2sqm per BPS, where courier can disload the equipment before Bioseco team arrives to site. There should be a Client representative to accept the shipment and secure it in the warehouse on arrival and return shipment of Bioseco container's (usually Substation building is used).
- Please check the technical specification of BPS for detailed technical description and technical requirements.
- Bioseco prepared a special document describing typical installation issues and interfaces which need to be agreed with the Client and turbine manufacturer before installation of BPS. This document is Attached as Appendix 4 to the offer- Guidelines on BPS installation

10. Exclusions and limitations

- Installation can only be done with wind speed <8m/s and no adverse weather conditions (heavy rain, snowfall) and in accordance to local H&S rules. Extra fee of 75 EUR/hour/technician (limit 4h per day) will be charged in case installation is not possible due to adverse weather conditions, lack of access to wind turbine, non-conformity with buyers obligations (lack of assistance for setting up the power supply, internet and Scada connection),
- Force Majeure applies as per industry standard inc. pandemic conditions,
- Prices are excluding VAT, which will be added as applicable,
- Bioseco limit of responsibility is max. 100% of proposed value of the works,
- Loss of profit and consequential damage is excluded from Bioseco liability

11. Offer validity

This offer is valid until 31.07.2023.

12. Appendices

1 - 3 Technical specification of BPS Standard Plus, Premium & BPS Long Range
4 – Guidelines on BPS installation
5 – Reference letters
6 – 23-05-2023 RWE Template RFQ Italy (xls)

Signed on behalf of Bioseco S.A. on 15.05.2023

Dawid Gradolewski (CTO)

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