REGIONE SICILIANA

COMUNE DI CONTESSA ENTELLINA

COMUNE DI SANTA MARGHERITA DI BELICE

COMUNE DI SAMBUCA DI SICILIA

COMUNE DI MENFI

Committente:

CONTESSA ENTELLINA
ENERGY & INFRASTRUCTURE

CONTESSA ENTELLINA S.R.L.
P.IVA 1329980960
VIA DANTE 7 MILANO C.A.P. 20123

Titolo del Progetto:

Progetto per la realizzazione e l'esercizio di un parco eolico denominato "Contessa Entellina" di 39,6 MW con sistema di accumulo di 12 MW e le relative opere connesse da svilupparsi nei comuni di Contessa Entellina (PA), Santa Margherita di Belice (AG), Sambuca di Sicilia (AG) e Menfi (AG)

Documento:

PROGETTO DEFINITIVO

N° Tavola: REL0014

Elaborato:

Studio Anemologico del sito

SCALA:	-
FOGLIO:	1 di 1
FORMATO:	A4

folder:	Relazioni progetto civile_Specialistiche	Nome File:	RS06REL0014A0.pdf

Progettazione:

NEWDEVELOPMENTS

ISO 9001 BUREAU VERITAS Certification

NEW DEVELOPMENTS *srl*
piazza Europa, 14 - 87100 Cosenza (CS)

Progettisti:

Rev:	Data Revisione:	Descrizione Revisione	Redatto	Controllato	Approvato
00	11/12/2023	PRIMA EMISSIONE	New Dev.	CONTESSA ENTELLINA	CONTESSA ENTELLINA

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NEX W 024 Contessa Entellina

Technical Data

Location	
Country	Italy
City	Contessa Entellina
Region	Sicily
Coordinates	
North	East
37°42'0.76"	13° 5'42.80"
Wind resource	
Wind speed Avg at 120 m	6,37 m/s
Weibull parameters	
A	K
7 m/s	1,48
Data wind source	Virtual mast (Vortex)
Plant	
Turbine	Siemens-Gamesa SG 170
Number	6
Power unit	6,6 MW
Power plant	39,6 MW

Energy Assessment

The energy yield prediction provides the basis for calculating project revenues. The aim is to predict the average annual energy output for the lifetime of the proposed power plant. For our case, the software selected by Nexta Project to perform Energy Yield Assessment is the Wind Atlas Analysis and Application Program (WAsP).

WasP is a software developed by Danish institute Riso DTU National Laboratory for Sustainable Energy. The code is based on three main data input:

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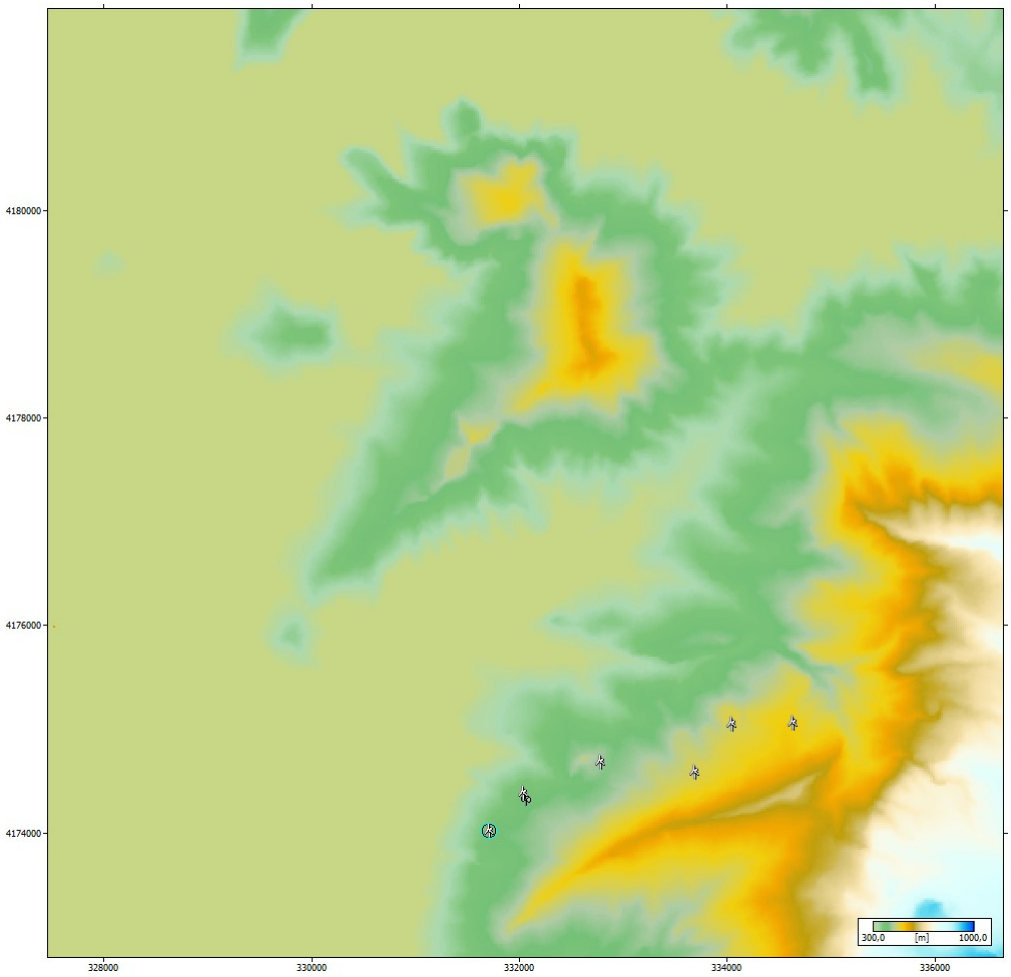
- Digital Terrain Model (DTM)
- Wind Map
- Turbine

DTM

A Digital Terrain Model (DTM) has to be imported in order to introduce orography in WAsP. This DTM was download from SRTM data, whit an extension of 10 km in all directions from wind turbines, ensuring total coverage of area.



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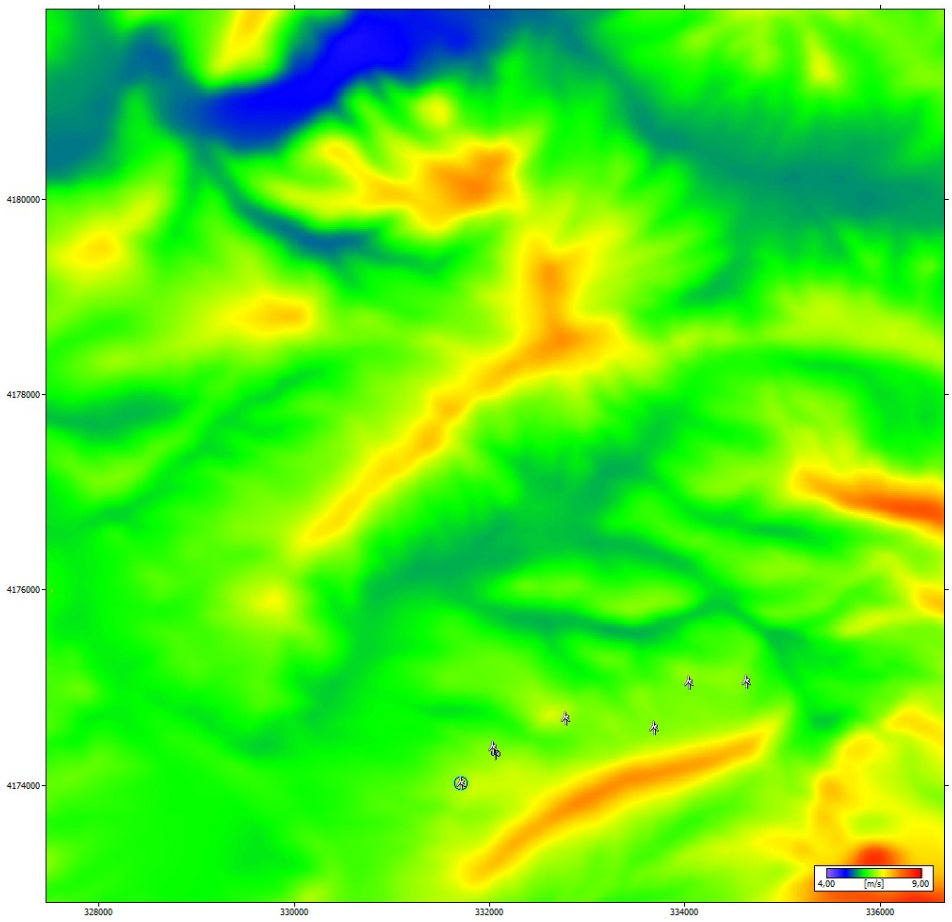
Wind Map

For obtain the wind map, we used to meso-scales wind data. In this case we used a virtual mast, that was made with the wind speed average of last 20 years of wind data zone. The virtual mast has been elaborated with ERA-5 data set, is a set of reanalysis data developed through the Copernicus Climate Change Service (C3S).

The calculus was realized at hub high (135 m) and a distance minimum of 1 km from each turbine for better optimize modeling the wind flow.



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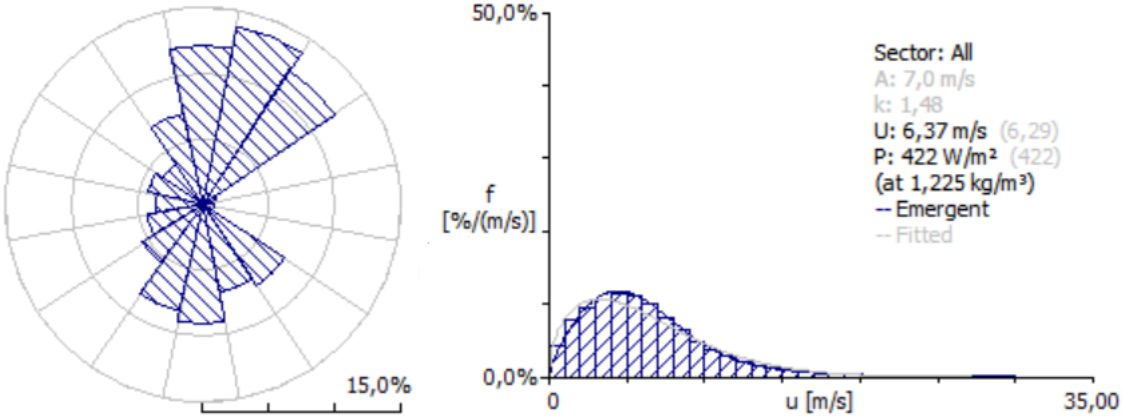
Mean wind parameters and wind rose:



Wind Turbine Generator (WTG)

For the chosen of WTG of Contessa Entellina wind farm, Nexta Project performed a layout optimization obtaining that the most suitable turbine is the Siemens-Gamesa SG 170 6,6 MW, turbine of wind class IIIa witch has the best fitting with the wind characteristics of study area.

Bellow the main features:

Rotor

- Type: 3 blades – axis horizontal
- diameter: 170 m
- Rpm: 10,5
- Swept area: 22.698 m^2
- Tilt: 6°

Blade

- Length: 83,5 m
- Material: Glass fiber – CRP (carbon reinforced plastic
- Color: RAL 7035 grey light

Tower

- Height: 135 m
- Type: Tubular Steel

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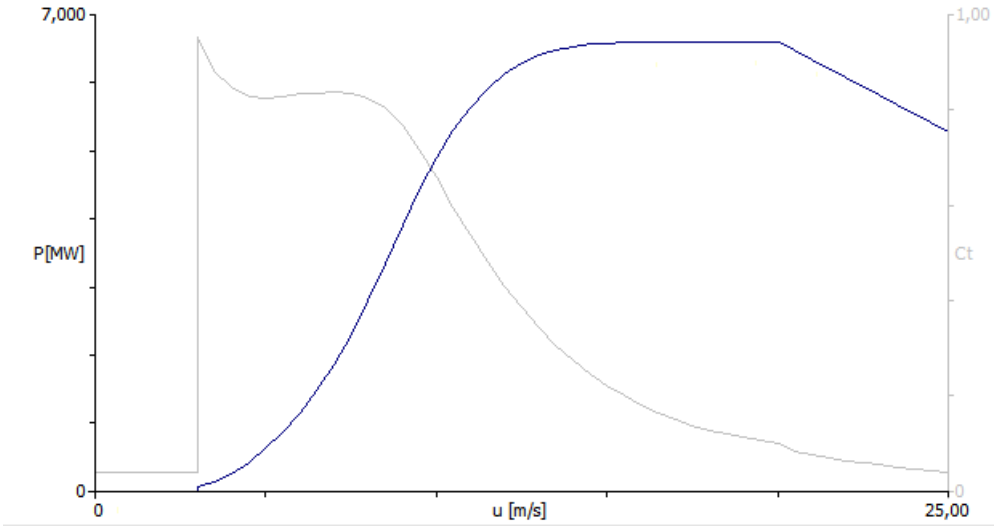
- Color: RAL 7035 grey light

Operational Data

- Cut in: 3 m/s
- Cut out: 25 m/s
- Rated: 11 m/s
- Re-start: 22 m/s
- Emissioni max. : 106 dBA
- Wind Class: IIIa - IIIb



SG 6.6-170	
Table 1 (1,030 kg/m³)	
Table 2 (1,060 kg/m³)	
Table 3 (1,090 kg/m³)	
Table 4 (1,120 kg/m³)	
Table 5 (1,150 kg/m³)	
Table 6 (1,180 kg/m³)	
Table 7 (1,210 kg/m³)	
Table 8 (1,225 kg/m³)	

Manufacturer	Siemens Gamesa
Web link	Undefined
Rotor diameter	170,0 m
Rated power	6,600 MW
Control system	Pitch
Default height	115,0 m
Comments	IEC IIIa/IIIb

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WTGs Coordinates

WTG	UTM Coordinates WGS84		Geographic Coordinates	
	E	N	E	N
WTG01	331713.107	4173942.535	37°41'50.19"	13° 5'28.12"
WTG02	332052.093	4174361.818	37°42'4.01"	13° 5'41.61"
WTG03	332841.190	4174601.120	37°42'12.29"	13° 6'13.62"
WTG04	333624.489	4174697.147	37°42'15.92"	13° 6'45.51"
WTG05	334068.330	4175017.016	37°42'26.58"	13° 7'3.37"
WTG06	334630.162	4174997.028	37°42'26.30"	13° 7'26.32"

Energy Yield

Losses

With the WAsP calculus is obtained the *Gross* **AEP** is defined as the energy calculation result for all WTGs as "free" and only include the wake losses and not include other factors. The calculus is based on modelling the virtual met mast, local effects (roughness, topographic and obstacle) and air density correction.

The real or *Net* AEP energy production, passes through a series of loss factors, in our case we used the following:

Factor		*Loss*
Availability	WTGs	3%
	Grid	2%
Losses	Electric	2%
	Mechanical	1%
O&M	WTGs	2%
	Sub Station	1%

Uncertainty

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The *Net* **AEP** figure is derived from the *Gross* AEP by including the losses all over the project lifetime. It is also known as the P_{50}, the AEP expected to be exceeded 50% of the time.

In this regard, the predicted annual energy yield is expressed within a given confidence interval. This approach supposes that over several years of operation, the distribution of the annual yields will follow a statistical law, which is assumed to be the Gaussian distribution.

For the wind power projects we give main importance to percentages that exceed to 75% and 90% (P_{75} an P_{90}), as required to banks entities.

The confidential interval of the predicted energy yield is given by uncertainties. Typically, the uncertainties refer to: wind data, wind model, power conversion and uncertainties on loss items. Below summarizes the uncertain used for categories and corresponding values:

Category		*Uncertainty*
Wind Data	Wind measurements	10%
	Long-term correction	1%
	Year-to-year variability	6%
	Future Climate	1%
Wind Model	Veritical extrapolation	*2%*
	Horizontal extrapolation	*5%*
Plant Performance and Losses	Power curve uncertainty	-
	Wake losses	*2%*
Other	Virtual model	*2%*

Result

Once definite all parameters of losses and uncertainties, we can introduce the values of gross AEP:

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Site	Turbine	Elevation [m] a.s.l.	Height [m] a.g.l.	Air density [kg/m^3]	Gross AEP [GWh]	Wake loss [%]	Net AEP [GWh]
WTG01	SG 170 6,6 MW	378	135	1,132	17,291	2,15	15,562
WTG02	SG 170 6,6 MW	380	135	1,136	17,44	2,8	15,696
WTG03	SG 170 6,6 MW	415	135	1,136	17,171	5,92	15,454
WTG04	SG 170 6,6 MW	452	135	1,142	18,436	1,65	16,592
WTG05	SG 170 6,6 MW	474	135	1,145	17,907	3,17	16,116
WTG06	SG 170 6,6 MW	517	135	1,146	17,937	5,96	16,143
TOTAL							95,564

Including the uncertainties:

	1 y	*15 y*	*30 y*
P_{50} [GWh]	95,564	95,564	95,564
P_{75} [GWh]	80,170	83,270	83,465
P_{90} [GWh]	66,285	72,180	72,552

In terms of equivalent hours:

	1 y	*15 y*	*30 y*
P_{50} [Heq]	2.413	2.413	2.413
P_{75} [Heq]	2.025	2.103	2.108
P_{90} [Heq]	1.674	1.823	1.832