

St. George Island Met Tower Extreme Wind Analysis

This report documents an analysis of extreme wind probability calculated from data collected from a met tower installed on Saint George Island, Alaska. With 25 months of data available, extreme wind probability was calculated as IEC 61400-1 Class I by 2nd edition criteria and Class II by 3rd edition criteria.

IEC 61400-1 Criteria

IEC wind turbine classification by extreme wind is shown in the table below for both 2nd and 3rd editions. Note that v_{ref} refers to the 10-minute mean wind speed at hub height with a 50 year return period, v_{G50} refers to the 3-second gust wind speed with a 50 year return period and v_{G1} refers to the 3-second gust wind speed with a 1 year return period.

IEC Wind Turbine Classes

WT Classes	I	II	III	IV	S
v_{ref} (m/s)	50.0	42.5	37.5	30.0	designer specified
v_{ave} (m/s)	10.0	8.5	7.5	6.0	
v_{G50} (m/s)	70.0	59.5	52.5	42.0	
v_{G1} (m/s)	52.5	44.6	39.4	31.5	

denotes 2nd ed. criteria not included in 3rd ed.

Extreme Wind Probability

Typically extreme wind probability is calculated with a best-fit Gumbel distribution using yearly maximum 10-minute average and 3-second gust data. This requires, however, a number of years of data; seven preferably. With a shorter time period of data, such as is the case with the St. George met tower, one can use a modified version of the Gumbel distribution that uses *monthly* maximum 10-minute average and 3-second gust data. By this method, the 10-min average and 3-second gust wind speeds in the table below are predicted for the indicated return periods.

St. George Met Tower Extreme Wind Probability

Return period (yr)	30 meters		37 m
	10 min mean (m/s)	3 sec gust (m/s)	10 min mean (m/s)
2	28.9	36.0	29.5
10	33.1	41.2	33.8
15	34.2	42.5	34.9
30	36.0	44.7	36.7
v_{ref} 50	37.3	46.3	38.0
100	39.1	48.6	39.9

Note: 37 meter 10-min mean probability calculated with a shear $\alpha = 0.096$

Note that, with reference to anemometer summary data table on page 2 of this report, that the St. George met tower site is IEC 61400-1 Class I by 2nd edition (1998) due to the mean annual wind speed at hub height exceeding 8.5 m/s. By IEC 61400-1 3rd edition criteria where v_{ave} is not considered, the site classifies as Class II.

Met Tower Information

The met tower was installed by TDX Power in September 2004 and data was collected until October 2006. Although the met tower is still standing, data logging is not active.

Tower Data

Met tower designation and type	Site 2401, 30 meter NRG tubular tower, six-inch diameter
Data start date	September 14, 2004
Data end date	October 4, 2006
Site coordinates	56° 35.193' N; 169° 36.878' w
Site elevation	130 ft (40 meters)

Met Tower Sensors

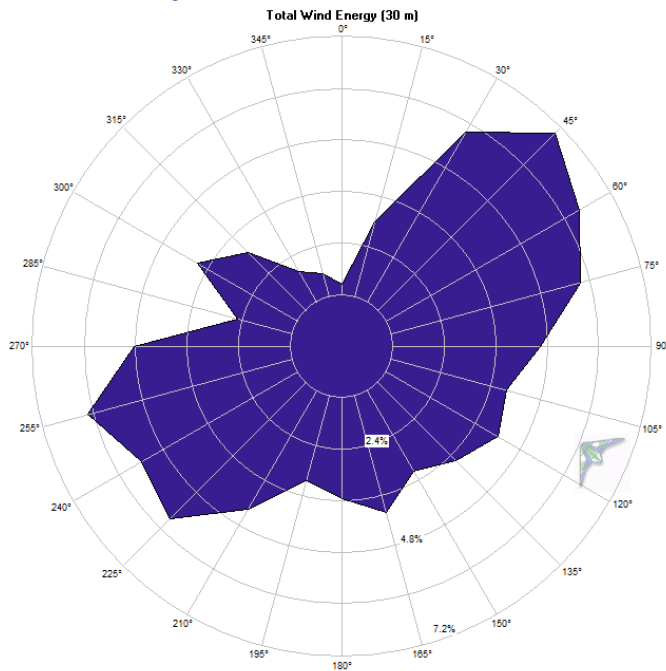
Channel No.	Sensor Type	Height	Offset	Boom Orientation
1	#40 anemometer	30 m	NRG standard	260° T
2	#40 anemometer	20 m	NRG standard	080° T
7	#200P wind vane	30 m	0	000° T
9	#100S temperature	5 m	NRG standard	North

Anemometer Summary Data

Month	30 meter anemometer					20 meter anemometer			37 m est.
	Mean (m/s)	Max 10-min (m/s)	Max gust (m/s)	Weibull k	Weibull c (m/s)	Mean (m/s)	Max 10-min (m/s)	Max gust (m/s)	Mean (m/s)
Jan	10.49	25.1	30.2	2.35	11.78	10.37	24.4	30.9	10.70
Feb	10.33	27.9	35.2	2.18	11.63	9.87	27.2	34.8	10.54
Mar	9.78	26.1	31.8	2.27	10.98	9.34	21.7	26.8	9.97
Apr	10.58	25.3	32.1	2.56	11.89	10.34	23.8	30.2	10.80
May	8.11	22.5	30.6	2.25	9.16	7.96	22.1	29.8	8.27
Jun	6.28	18.2	22.9	1.94	7.07	6.23	17.6	22.6	6.40
Jul	7.12	19.2	24.4	2.24	8.04	6.71	18.2	23.7	7.26
Aug	7.70	22.8	30.6	2.10	8.70	7.31	21.3	30.2	7.85
Sep	9.87	26.2	32.1	2.16	11.11	9.26	26.0	33.6	10.07
Oct	11.18	27.1	36.7	2.21	12.59	10.43	25.9	35.5	11.41
Nov	12.01	33.5	40.1	2.57	13.48	11.34	26.5	36.7	12.25
Dec	9.71	27.4	34.0	1.82	10.90	9.46	27.5	33.2	9.91
All	9.43	33.5	40.1	2.05	10.63	9.04	27.5	36.7	9.63
MMM	9.42					9.04			9.61

Note: 37 meter estimated mean wind speed calculated with shear $\alpha = 0.096$

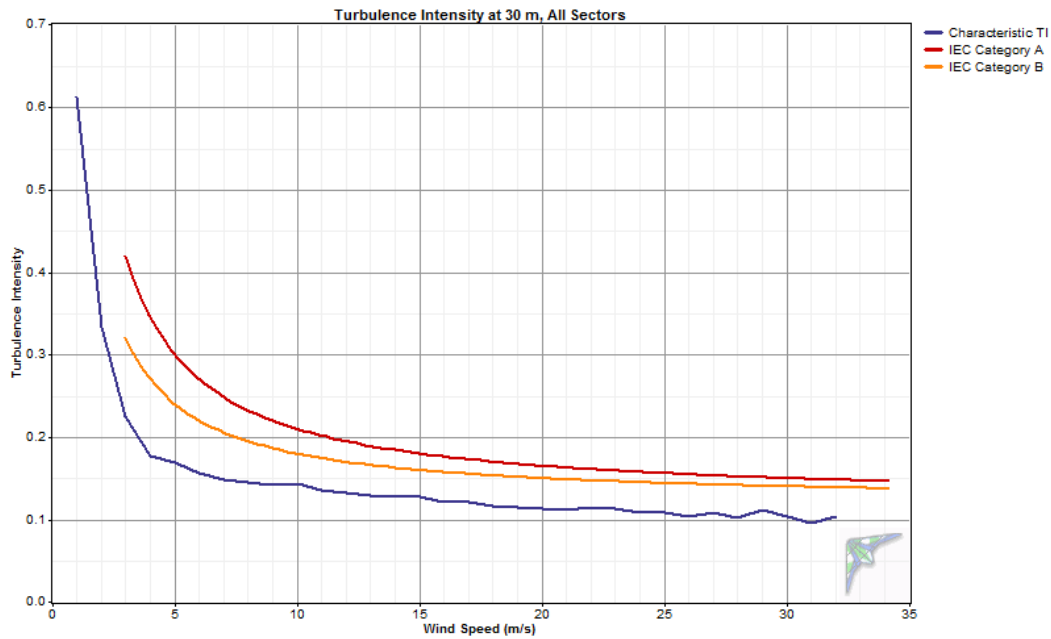
Power Density Wind Rose



Turbulence

The St. George met tower site experiences turbulence category B winds by IEC 61400-1 2nd edition criteria and turbulence category C winds by 3rd edition criteria with a mean turbulence intensity of 0.098 and a characteristic TI of 0.127 at 15 m/s (all sectors, 30 meters).

Turbulence Intensity at 30 meters, IEC2 Criteria



Turbulence Intensity at 30 meters, IEC3 Criteria

