TEMPERATURE DERATING IN PARK

Purpose:

The purpose of this quick guide is to show how to apply temperature derating in a PARK calculation.

Temperature derating refers to the ability in modern wind turbines to limit the power output to avoid overheating in the nacelle. The actual derating will depend on internal temperatures and pressures inside the gear, generator, transformer etc. Many manufacturers provide a temperature derating curve approximating when the turbine should derate as a function of ambient temperature and elevation.

Outline of Guide:

1. **Requirements**

2. **Defining the temperature curve**

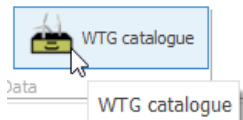3. **Temperature derating in PARK**

4. **FAQ**

1. REQUIREMENTS

A set of maximum allowed power outputs by elevation and temperature.

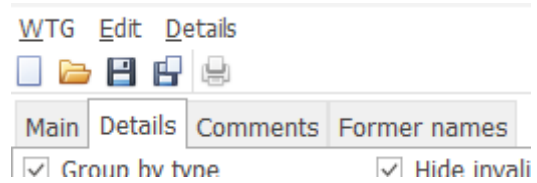An activated license to PARK.

2. DEFINING THE TEMPERATURE CURVE

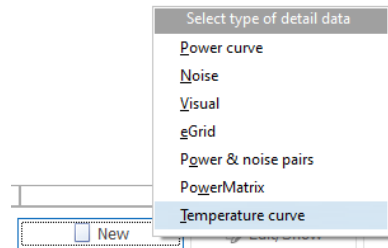Open the wind turbine catalogue:

Select your desired turbine model:

Go to the Details tab:

Click the New button to add a new dataset and select Temperature Curve:

Now set the number of elevation steps and temperature steps as provided by the manufacturer:


In this case there's 13 temperature steps and 8 elevation steps. Notice that there is no lower elevation for which the turbine will shut down. However, there is a maximum elevation. Placing a turbine above the specified threshold will shut down the turbine. Likewise, there is a minimum and maximum temperature range which the turbine is operational within. If the ambient

temperature exceeds one of these thresholds, the turbine will shut down. The table where the outer cells always are zero:

Elevat	Temp < -20,0	Temp -20,0	Temp 16,0	Temp 18,0	Temp 19,0	Temp 21,0	Temp 23,0	Temp 24,0	Temp 25,0	Temp 26,0	Temp 30,0	Temp 35,0	Temp 40,0	Temp 45,0	Temp >= 45,0
-1	0	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.200	4.000	3.602	2.635	700	0
500	0	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.200	4.000	3.574	2.595	700	0
750	0	4.500	4.500	4.500	4.500	4.500	4.500	4.500		4.200	4.000	3.566	2.566	700	0
1.000	0	4.500	4.500	4.500	4.500	4.500	4.500			4.200	4.000	3.608	2.524	700	0
1.250	0	4.500	4.500	4.500	4.500	4.500			4.200		3.950	3.580	2.515	700	0
1.500	0	4.500	4.500	4.500	4.500			4.200			3.900	3.549	2.486	700	0
1.750	0	4.500	4.500	4.500			4.200				3.850	3.500	2.462	700	0
2.000	0	4.500	4.500			4.200					3.800	3.450	2.509	700	0
= 3.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

One tip is to copy the table into excel and enter the information there, and then paste it back into windPRO:

Copy
Paste
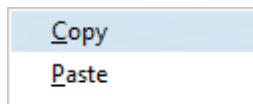
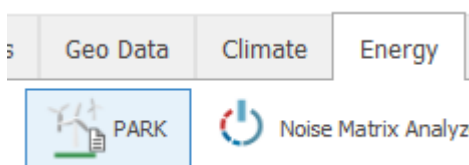As you fill in the table, you can see a plot of the temperature curves across elevations:
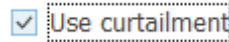

Max Power
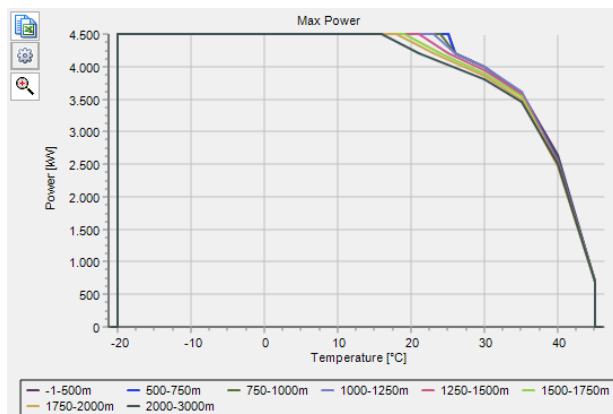
Once satisfied, click OK, and then Save

WTG Edit De

3. TEMPERATURE DERATING IN A PARK CALCULATION

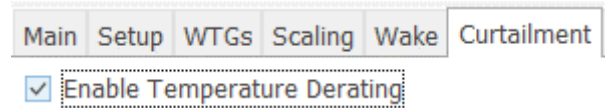To use the temperature curve simple open a PARK calculation in the Energy tab:

Geo Data   Climate   Energy

PARK   Noise Matrix Analyz

Select a time varying energy calculation and go to Setup

and enable Curtailments

☑ Use curtailment

Go to the Curtailments tab and Enable "Enable Temperature Derating".

Main Setup WTGs Scaling Wake Curtailment
☑ Enable Temperature Derating

Select the source of temperature signal:

Signals used in curtailment conditions	Take signal from
Temperature	Meteo object
	Scaler
	Meteo object
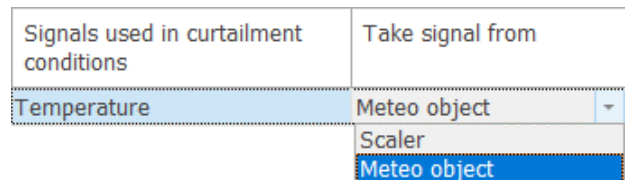
Click OK to start the calculation.

The loss from the temperature derating can be found in the Production Analysis report as a curtailment:

Sector		0 N	1 NNE	2 ENE	3 E
Gross	[MWh]	0,0	0,0	0,0	36.621,0
-Decrease due to curtailments	[MWh]	0,0	0,0	0,0	1.577,0
Decrease due to temperature curve	[MWh]	0,0	0,0	0,0	1.577,0

And is included in the overall curtailment loss figure on the Main report.

Additional information can be found in the Curtailment Assumptions report.

Temperature Derating
6 out of 6 turbines have been temperature derated

Loss: 5607,43 MWh
Loss: 3,41 %

4. FAQ

Q: Can I work with multiple temperatures curves?

A: Yes, for different turbine models. However, each turbine model can only contain 1 temperature curve. It is unfortunately not possible to toggle between different temperature curves in the WTG objects. Although this would be nice.

Q: How does temperature derating interact with other curtailments?

A: The temperature derating works like all other curtailments except that it is applied across all turbines

of a particular model. It is the first rule to evaluated, before any WTG-specific rules. If any subsequent curtailment rules are capable of yielding additional losses, these will be executed afterwards. The order of loss attribution is as follows:

GROSS production
   └──Wake
        └──Temperature derating
             └──All other WTG Curtailments (by priority)
                └──Grid limitations

Q: Which elevation is PARK using?

A: When PARK looks up the elevation of the turbine to be temperature derated, it uses the elevation + hub height.

Q: How is temperature derating handled in LOSS & UNCERTAINTY?

A: If temperature derating has been activated in a PARK calculation it will appear as a new line under curtailments in LOSS & UNCERTAINTY.

Birds			0,00	0
Bats			0,00	0
Temperature Derating	Included		41,15	75.345
Other curtailment			0.00	0