

# Loss & Uncertainty

## Bringing the PARK Calculation to a Bankable Level



### Function

Calculation of losses and uncertainties for a wind farm project to reach a bankable level. Includes also annual production at exceedance levels between P50 and P99, as well as the possibility to correct for systematic errors as e.g. in complex terrain (RIX correction). The Loss & Uncertainty module requires the following calculation, for which the evaluation will be performed:

- PARK

For accurate calculation of different loss and uncertainty components the module also offers to import data from e.g.:

- METEO-Object (time series with relevante parameters for e.g. curtailment)
- SHADOW, DECIBEL – for calculation of losses due to environmentally given reduction modes.

### Calculation Method

A previously calculated PARK calculation is loaded, and possibly also a time series, which in addition will allow for calculation of losses with a time dependent perspective. In the basic approach the user can simply insert values for each loss and uncertainty component in a well-structured way based on own experience and hints in module text. In the more thorough approach it is possible to calculate many of the losses and several uncertainty components within the module based on detailed calculation algorithms and extended data describing how the loss or uncertainty is linked to site-specific parameters. If there are known problems with the measuring equipment or a RIX (terrain Ruggedness Index) calculation is included in the loaded PARK calculation, it is also possible to calculate and correct for such systematic errors in the Bias correction part of the module.

### Necessary Input Data (Objects)

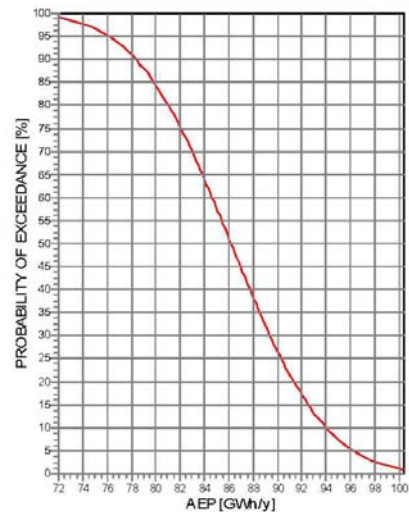
A PARK calculation is required for a Loss & Uncertainty calculation. Please read the PARK description for further details and requirements of this calculation.

### Description

Once a PARK calculation is performed there are still several issues to be considered before a wind farm project is ready to take to the bank. The Loss & Uncertainty module is an efficient and structured way of addressing these remaining issues. In a wind farm project several important losses have to be considered and their resulting reduction calculated; the module helps the user through this process with a full list of the relevant losses. The losses are grouped and organized according to the recommendations made by an international group of experts. A few examples of losses that can be calculated in the module are losses due to: high wind hysteresis, wind sector management and fully customizable curtailment settings.

The assessment of project AEP uncertainties is an equally important step to enable evaluation of the risk of the investment. In the module all the important uncertainty components are grouped according to origin. The main uncertainty components resulting from horizontal and vertical extrapolation may be calculated using a setup based on EMD's vast experience from projects in Denmark and around the world. Uncertainty due to the power curve may also be calculated according to the IEC61400-12 standard.

In complex terrain industry standard flow models like the WAsP model may come short. In the bias correction part of the module it is possible to automatically correct for such model shortcomings in particular via the so-called RIX correction, provided that a RIX calculation is included in the utilized PARK calculation.



### Calculations report

The Loss & Uncertainty module provides the user with thorough documentation possibilities via its extensive report options. The main report page can be shown either for the wind farm as a whole or for the turbines individually, depending on how the project is sold (if so). The main report page gives a solid overview with all the key figures and illustrative, easy to understand graphics, also emphasizing where the project calculations or data background might be improved. Following the main report the major loss and uncertainty (and bias if included) components are summarized with the important assumptions made in each calculation. Finally, the module provides a detailed calculation report for each component calculated in the "thorough" approach.

**Data to file** – Detailed WTG-wise results and sub-results can be copied to clipboard/text-file for further analyses in other software tools.