

EeFarm-II



EWIS

Being one of the leading institutes on wind energy research, ECN established the EWIS (ECN Wind Industrial Support) group in 2009 to better bring the R&D results to the market. During the last three decades, ECN has developed expertise on aerodynamics, structural analyses, turbine control, offshore operation and maintenance, and grid connection. With the growing wind industry, ECN received more requests for assistance and EWIS has become the vehicle to support the wind energy industry in their product developments.

EWIS's focus is on the high end of the market which means that we will make use of tools and knowledge that have been developed in-house and include the latest R&D results!

The EWIS team is a mixture of young professionals and experienced researchers which ensures a fast response and high quality.

More information

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Product description

The Software

EeFarm-II has been developed to study and optimise the electrical performance of wind farms. The program is used to determine the energy production, electrical losses, component failure losses and the price of the produced electric power of a wind farm. The program consists of a component library, a component database and a postprocessor. The component library contains steady state models of turbines, generators, transformers, AC and DC cables, PWM (pulse width modulated) and thyristor converters and of an inductor, statcom and chopper.

EeFarm-II is programmed in MATLAB -Simulink. By using a component library, structured component parameters and a single bus signal to connect the different components in a wind farm, it is very easy for the user to build his specific wind farm model. After choosing the wind farm component blocks from the library and connecting the component blocks in Simulink, the parameters of all wind farm components are loaded by preparing a small MATLAB file that calls the database and selects the component data to be fed to individual components. Wind speed and wind direction data generated by a wind farm wake program, for instance FarmFlow (also developed by ECN), can be fed into the turbine blocks.

The Model

EeFarm-II calculates the voltage, current, active and reactive power of the main electrical components in a wind farm. The calculation starts at the turbines and proceeds in the direction of the high voltage grid. The AC component models are the well known equivalent circuit diagrams for generators (induction, doubly fed and full converter), cables and transformers. For the PWM converter three different models representing the switching and conduction losses can be chosen. EeFarm-II does not solve the load flow in the classical way because this would make it difficult to include DC components. Instead, it determines an average solution which is sufficiently accurate to determine the losses and the produced power. This is repeated for each wind speed bin of the turbine power curve. The average solution is sufficiently accurate due to the small voltage drops and the small voltage angle differences in a wind farm. The results for each wind speed bin are combined with the wind speed distribution to determine the energy production and the price of the produced electric power.

Specifications

Description of Software:	<ul style="list-style-type: none">• EeFarm-II (Matlab-Simulink library, database and post processing)• Program description
Designated sites:	single user
Licence fee:	€ 10 000
Licence term:	unlimited use
Services:	one day technical and software support (by telephone and/or e-mail, not on-site)
Maintenance services	16 man-hours software support (by telephone and/or e-mail, not on-site) and, if available, an update of the software
Maintenance Fee	€ 2 500
Additional options:	one-day training with a demonstration of EeFarm-II and hands-on practice, given by ECN experts

For more information about this service, please contact:

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The Database

EeFarm-II calculations require component parameters (typically resistances, capacitances and inductances) and budget prices which are stored in a component database. Ideally the parameters and budget prices should be supplied by component manufacturers and should be updated regularly. A database with manufacturer supplied component parameters is included; budget prices however are not included due to confidentiality agreements.

The Experience

EeFarm-II was originally developed by ECN and Delft University of Technology in MATLAB. To improve user-friendliness, it was completely rebuilt in MATLAB-Simulink, exploiting the advantages of the Simulink graphical user interface and MATLAB data structures. This second version was developed and tested in collaboration with Vattenfall Sweden. Vattenfall was also the first customer of EeFarm-II. The models comprising the program have been partly validated (only AC components) by comparison to the Vision load flow program.

EeFarm-II has been developed with financial support from the We@Sea research program.