

- Optimised and efficient switch-off algorithms
- Shutoff at times of low wind speed
- Concise switch-off tables
- Software interface independent from turbine manufacturer (HTML)
- Universal turbine controlling and data acquisition interface
- Optimisation dependent on turbine power
- Integration in Optifarm system
- Development born out of operation management practice



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Shade shutoff system Shadeoff

The shade shutoff system Shadeoff is based on optimised switching algorithms to minimise energy losses as far as possible. Situations of shading from several turbines are taken into consideration as well as the current measured power to optimise switch-off times. The basic version of the shutoff system consists of a control computer with WEB server function and an (optional) hardware module to switch-off the turbines, an optional solar radiation sensor which is mounted on top of the turbine nacelle and the accordingly controlling software.

Hardware

The basic hardware consists of a local installed computer in industry quality including the software to control the turbines. If an Optifarm server is already installed no additional computer is required. In this case the controlling software module is integrated in the Optifarm system. If necessary the turbines will be switched on/off using the turbines input (switch) ports by a small external hardware box which also has some analog ports to acquire operating data (power, status, ...). Using directly an serial interface to the turbine control processor makes this external box obsolete, dependant on manufacturer. For external login (RAS) an ISDN or modem interface is integrated.

Configuration

The control software will be configured according to the wind farm configuration, the building permission and the shade expertise relevant for permission. The switching of the machines will be optimised to minimise energy losses as far as possible.

Basis for the online switch-off optimisation is the involvement of

turbine power and status signals to switch of turbines at zero or low power conditions if possible.

Documentation

The enforced shutoff events are permanently documented and can be sent automatic by email for instance every month. Using the WEB server function current status can be controlled at any time and allows online insight into the switching tables. The switching tables are available as ASCII and PDF documents. They are not overwritten even after longer time periods and are accessible at any time.

Universel control and data interface

Turbine operational data like electric power, wind speed and status as well as switching commands can be transferred using different interfaces: analog – logging or switching a low voltage using the external hardware box or in digital form with control commands using a serial interface (RS232, RS485, Ethernet). Customisation is easily possible by adapting scripts.

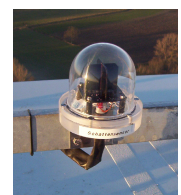
Sunshine sensor

The sun shine sensor is installed on top of turbine nacelle save from vandalism. The sensor is direction-independent and tolerant in relation to briefly arising shade of e.g. the rotor blades.

Links

www.overspeed.de

www.optifarm.de





Requirements to install Shadeoff

- Precise measured coordinates of the shade immission points.
- Precise measured coordinates of the turbines.
- Permitted daily and yearly shade times at the shade immission points
- The permission relevant shade expertise (can be provided by us) and the building permission to identify the configuration parameters.
- Supply of the electrical power signals of the turbine in analog form (4-20mA, 0-5V) or in digital form using a serial interface (RS232, RS485, Ethernet).
- Supply of control inputs to switch on/off the turbines in analog form (switching of a low voltage) or in digital form (control command) using a serial interface (RS232, RS485, Ethernet).
- Optional: Supply of Turbine status signal and wind speed signal.

Current Status: Wind farm with 3 turbines

Status 2003/09/13 13:19	WT3	WT4	WT6
At present switched off	no	no	no
Power signal	ok	ok	ok
Current power [%]	41	45	52
Sum of switch-off times	00:00	00:00	00:59

Status 2003/09/13 13:19	IP 1	IP 3	IP 5	IP 6
Permitted shade time per day	00:30	00:30	00:30	00:30
Permitted shade time per year	30:00	27:57	29:13	30:00
Yearly sum of possible shade times	26:37	33:25	39:51	17:03
Total Time to switch off (this year)	00:00	05:27	10:38	00:00
Time already switched off	00:00	00:00	00:59	00:00
Remaining time to switch off	00:00	05:27	09:39	00:00
Shade switching at present active	No	No	No	No

Documentation of shutoff times

Shutoff Times for Immission Point 8:							
Start Date	Start Time	End Date	Sun [yes[--]]	End Time	Duration [Sec]	WT [No.]	Shutoff Sum [Min]
16.09.2003	17:34	16.09.2003	yes	17:38	240	9	4
17.09.2003	17:30	17.09.2003	yes	17:42	720	9	16
18.09.2003	17:27	18.09.2003	yes	17:43	960	9	32
19.09.2003	17:26	19.09.2003	yes	17:44	1080	9	50
20.09.2003	17:24	20.09.2003	yes	17:45	1260	9	71
21.09.2003	17:23	21.09.2003	yes	17:45	1320	9	93
22.09.2003	17:22	22.09.2003	Yes	17:45	1380	9	116
23.09.2003	17:22	23.09.2003	yes	17:45	1380	9	130

Shutoff Time of Turbine 9:									
WT No.	IP No.	Switch Date	Switch Time	Status [ON OFF]	WT No.	IP No.	Switch Date	Switch Time	Status [ON OFF]
9	6	25.08.2003	06:41	OFF	9	6	25.08.2003	06:58	ON
9	6	27.08.2003	06:37	OFF	9	6	27.08.2003	07:01	ON
9	6	29.08.2003	06:34	OFF	9	6	29.08.2003	07:02	ON
9	6	01.09.2003	07:02	OFF	9	6	01.09.2003	07:03	ON
9	6	02.09.2003	06:43	OFF	9	6	02.09.2003	07:03	ON
9	6	03.09.2003	07:01	OFF	9	6	03.09.2003	07:03	ON