Shadeoff
The Optimising Shade Shutoff System for Wind Farms

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- Optimised and efficient switch-off algorithms
- Shutoff at times of low wind speed
- Concise switch-off tables
- User-Interface HTML
- Universal turbine controlling and data acquisition interface
- Optimisation dependent on turbine power
- Integration in scada system
- Direction independent solar sensor
- Development born out of operation management practice

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Shadeoff

According to requirements of the authorities, specific shading hours of wind turbines at residential buildings should not be exceeded, ensured by a shade shut-off system.

Our shade shut-off 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 account as well as the current measured power to optimise switch-off times.

The shade shutoff system consists of a control computer with WEB-server function and a software interface or a hardware module to switch-off the turbines, a solar radiation sensor which usually is mounted on top of the turbine nacelle and the according controlling software.

Hard- und Software

As control computer usually the existing scada PC is used on which the software is operated in parallel to control the turbine shutdown.

Optimally, control of the turbine and acquisition of status data is done via a software interface.

As an alternative, the turbines are controlled by our separate switching module via analogue switching outputs and operating data are captured via analogue inputs (power, status). Using the installed WEB-interface, status data can be monitored easily.

Configuration

The control software will be configured according to your wind farm setup, taking account the building permission of the authorities and the shade expertise relevant for permission. Switching of the turbines 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-off turbines at zero or low power conditions where possible.

Documentation

The enforced shut-off events are permanently documented in ordinary text files. Using the WEB server function on the scada server current status can be controlled at any time and allows online insight into the switching tables. The switching tables are not overwritten, even after longer time periods and are accessible at any time.

Universal 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: usually a software interface, or alternatively by control commands using a serial interface (RS232, RS485, Ethernet), or analogue by logging or switching a low voltage using our separate switching module.

Solar radiation sensor

The solar sensor for detecting direct solar radiation is usually installed on top of the turbine nacelle, save from vandalism. The sensor is direction-independent and tolerant in relation to briefly arising shades of e.g. the rotor blades.

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Requirements to prepare and install Shadeoff

- Precise measured coordinates of the shade immission points and immission zones.
- 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.
- Providing of electrical power signals of the turbine via a software interface, or using a serial interface (RS232, RS485, Ethernet), or in analogue form (4-20mA, 0-5V)
- If a software interface is not present, providing of control inputs to switch on/off the turbines in analogue form (switching of a low voltage) or in digital form (control commands) using a serial interface (RS232, RS485, Ethernet).
- Optional: Supply of Turbine status signal and wind speed signal

Current status example: wind farm with 3 turbines

Status 2013/09/13 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 2013/09/13 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 example of shut-off 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	16.09.2013	yes	17:38	240	9	4
17.09.2003	17:30	17.09.2013	yes	17:42	720	9	16
18.09.2003	17:27	18.09.2013	yes	17:43	960	9	32
19.09.2003	17:26	19.09.2013	yes	17:44	1080	9	50
20.09.2003	17:24	20.09.2013	yes	17:45	1260	9	71
21.09.2003	17:23	21.09.2013	yes	17:45	1320	9	93
22.09.2003	17:22	22.09.2013	Yes	17:45	1380	9	116

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	25.08.2013	06:41	OFF	9	6	25.08.2013	06:58	ON
9	6	27.08.2013	06:37	OFF	9	6	27.08.2013	07:01	ON
9	6	29.08.2013	06:34	OFF	9	6	29.08.2013	07:02	ON
9	6	01.09.2013	07:02	OFF	9	6	01.09.2013	07:03	ON
9	6	02.09.2013	06:43	OFF	9	6	02.09.2013	07:03	ON
9	6	03.09.2013	07:01	OFF	9	6	03.09.2013	07:03	ON