Document no.: 0015-4637 V05
—2017-09-18

General specification yaw power backup

V52-850 kW, V80-2.0 MW, V90-1.8/2.0 MW V100-1.8 MW, V100-2.0/2.2 MW, V110-2.0/2.2 MW, V116-2.0 MW and V120-2.0/2.2 MW.

VPM 5000.2 and VMP Global™

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Version no.	Date	Description of changes
05	2017-09-18	Updated the wind turbine type.

Table of contents

1 Terms and abbreviations

Term or abbreviation	Definition
PBS	Power backup system
SCADA	Supervisory control and data acquisition
UPS	Uninterruptable power supply
YPB	Yaw power backup
WTG	Wind turbine

Table 1-1: Terms and abbreviations.

2 Disclaimer

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3 General description

The YPB system enables the WTG to yaw in wind speeds above the standard cut-out wind speed. An external power backup system – not necessarily supplied by Vestas - provides power backup and a special operational mode that ensures continuous yawing at normal speed. The additional sensors enable the turbine to yaw in wind speeds up to 70 m/s. The YPB system provides power backup during periods when the grid is unavailable.

3.1 System description

The YPB system consists of three main elements:

- A central placed power backup system that delivers power to the yaw system in the turbine when the grid is unavailable.
- An extended yaw mode in the individual turbine which allows the turbine to ignore certain warnings and alarm that normally would prevent yawing.
- An additional wind measurement system which consists of an extra wind vane and a cup anemometer. This wind measurement system is approved for wind speeds up to 70 m/s.

The system is designed to make the wind sensors and software working independently of the power backup system. Hence the turbines can be powered from the grid when available.

For correct park integration of the YPB system, it is required that the UPS capacity in all turbines, SCADA, and the Power Backup system allows for

at least five minutes backup supply after the grid is down. This allows sufficient time for the Power Backup system to take over the power supply.

4 Operational strategy

Figure 4-1, p. 4 shows the operation sequence for the operational strategy when a typhoon passes by. The same scenario will occur in other extreme high-wind situations and differs depending on the wind conditions.

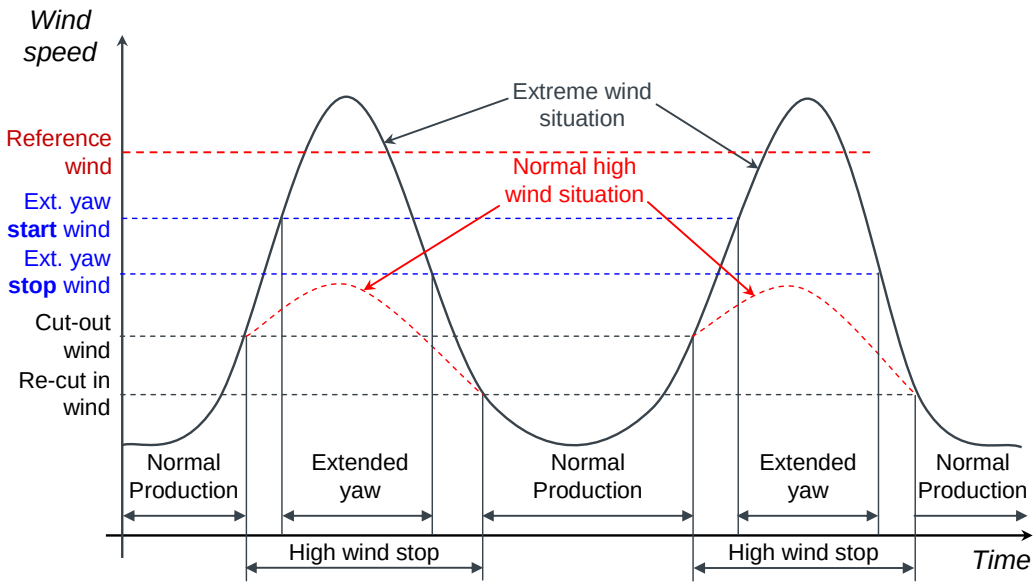

Figure 4-1: Operational strategy for YPB

The turbine will maintain the normal limits for cut-out and cut-in at high wind speeds and report the high wind speed alarm to SCADA as usual. If the wind speed during the high wind speed alarm increases above the extended yaw start value (variable setting in turbine software. Minimum value = cut-out wind speed) the turbine will enter into EXTENDED YAW mode. The EXTENDED YAW mode is a mode enabling the turbine to yaw in situations where yawing normally would be prohibited due to alarms. The turbine will remain in this mode until the wind speed is reduced below the extended yaw stop value (variable setting turbine software. Minimum value = re-cut in wind speed).

During EXTENDED YAW mode, some alarms and the warning in the turbine software will be ignored to ensure the continuous yawing. Ignored alarms and the warnings depend on the software version and the turbine type. None of the ignored alarms are critical to personal or structural safety.

After the wind speed drops below the re-cut in wind speed, the turbine will automatically restart the production if the grid is available. The exception is when the turbine has ignored warnings or alarms during the EXTENDED YAW mode. The ignored warnings and alarms are combined in one single alarm which must be manually acknowledged before the turbine can

resume normal production. Ignored alarms have no impact on personal and structural health and safety.

The sensors and software can work independently of the power sources. If the external power backup system is active, the turbines will not be producing power to the grid.

In case the park has been running on the power backup system and wind speed is reduced to normal cut-in level, the decision to stop the power backup system is completely manual. The process of reconnecting the entire park to the grid is also depending on the local requirements and the procedures.

5 Wind sensor description

The yaw power backup system consists of an extra set of wind sensors (cup anemometer and wind vane). During normal operation, the turbine is controlled by the standard sensor. The additional sensors are taking over the control of the turbine when the wind speed reaches the cut-in wind speed for the EXTENDED YAW mode (defined site specific).

Wind sensors	
Type	Thies First Class
Principle	Mechanical
Built-in Heat	25 W
Max wind speed	70 m/s

Table 5-1: Wind sensor data

The extra set of wind sensors are used to provide wind direction and wind speed data in wind speeds up to 70 m/s.

6 Power backup system

The power backup system consists of one or more generators including automatic control. The size of the power backup system is determined based on the park size and the turbine type, which is calculated in document 0021-4728 ‘Calculation of diesel generator for Power Backup System’. Furthermore the power backup system must follow Vestas design guidelines document 0021-4730 ‘Design guideline Power Backup System’ and the technical purchase specification 0015-7251.

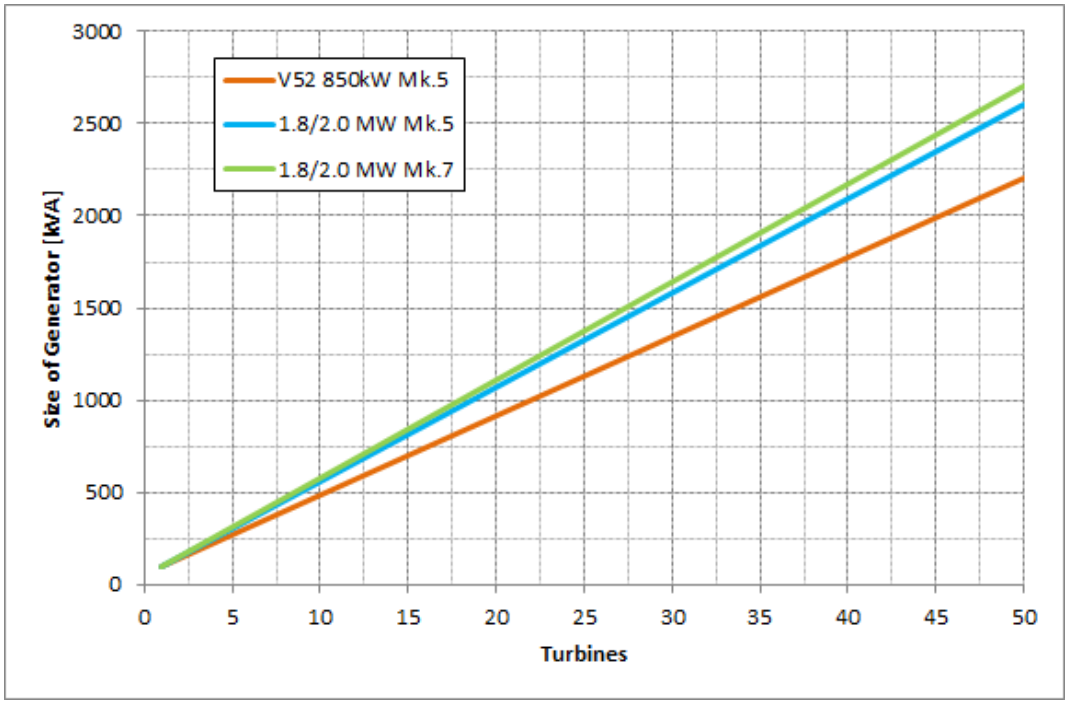

Figure 6-1: Size of the power backup system

The power backup system is activated (AUTO START mode) through the Vestas SCADA system or manually on the generator controller panel. The actual power backup cut-in is done automatically when the grid is down and the power backup system is activated.

7 SCADA description

The Vestas SCADA system acts as an information provider as well as a control unit for the yaw power backup system. Hence, the SCADA system must be active and powered. Furthermore, uninterrupted communication lines between the SCADA system and the turbines are required.

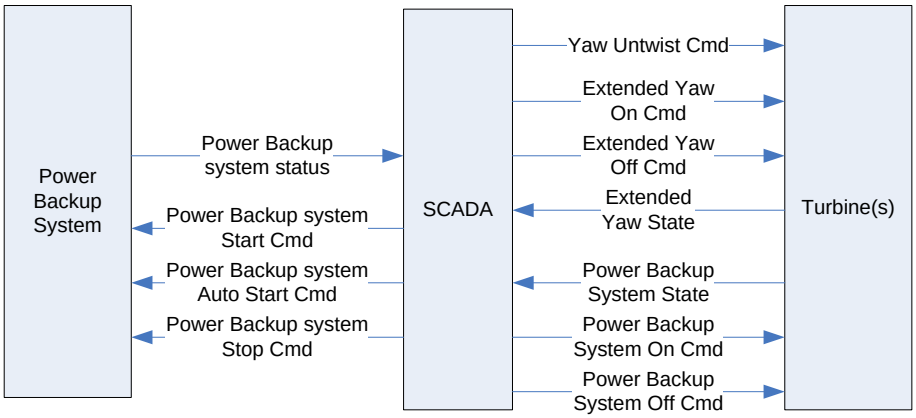

Figure 7-1: Interfaces between the power backup system, SCADA and the turbines

SCADA functions	
Action:	**Description:**
PBS start-up command	Start-up of the PBS
PBS auto start-up command	PBS ready to start-up, when the grid is lost
PBS stop command	Stops the PBS
Yaw untwist command	Untwists the HV cables
Extended yaw on command	Force the turbines into the extended YAW mode
Extended yaw off command	Force the turbines out of the extended YAW mode
Information:	**Description:**
Extended yaw state	Shows when the turbines are in extended YAW mode
Power Backup system status:	
- System on	Shows when the PBS is running
- System off	Shows when the PBS is not running
- System error	Shows when the PBS has an error
Active/reactive power output from the PBS:	
- Generator P	Active effect
- Generator Q	Reactive effect
- Transformer P HV	Active effect
- Transformer Q HV	Reactive effect
Status on PBS transformer:	
- Voltage HV	Voltage indicates active system and W level

SCADA functions	
- Current HV	Current at HV side

Table 7-1: SCADA functions

The turbine is informed about the external power backup supply from the SCADA (‘Power Backup Supply On Command’) system and will activate a supervision (alarm) based on that. This supervision will prevent production until it is acknowledged by the park operator via SCADA. The supervision cannot be acknowledged until the ‘Power Backup Supply Off Command’ has been sent from SCADA.

8 Appendix

8.1 Single line diagram

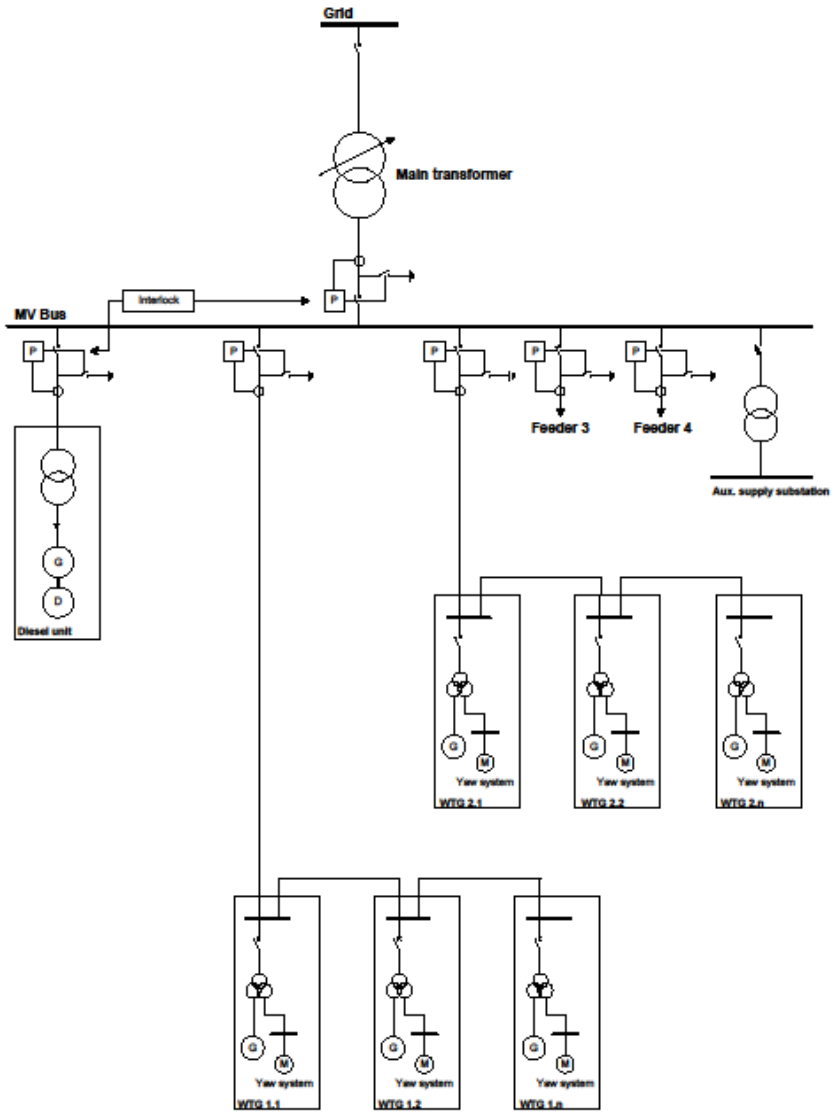

Figure 8-1: Single line diagram