Date
Videbæk, Friday, 23rd of January 2015

Description: Fullabrook "2761_P04_2014-11-17_EXT1_Fullabrook_Further_ Updated _Mitigation_Strategy"
Account: ESBI Engineering Ltd.
Contact Person: Alan Canty
Request process: Direct Reply
Project No: 19488
Service Team: C-Support NorthEMEA WTG Engineering & Support
Employee Responsible: Mr. Lars Peter Hansen
Employee SCADA: Mr. Carsten Holm Jensen
Employee Requestor: Mr. Frederick Greene

I can hereby confirm that Vestas has finished the implementation of the noise mitigation strategy in all the turbines and also on the SCADA system at Fullabrook wind farm.
The turbines and the SCADA system are now operating with settings according to the document 2761_P04_2014-11-17_EXT1_Fullabrook_Further_Updated_Mitigation_Strategy.....xlsx.

The Vestas SCADA specialist has developed and introduced the Sector Wind Direction Pause system controlled by the Power Plant Controller.
This new feature was successfully tested and reviewed in the time period from Thursday, January 15th 2015 to Tuesday, January 20th 2015.
The Sector Wind Direction Pause system was fully integrated and activated on the Fullabrook SCADA system on Wednesday, January 21st 2015.

On the following pages you will find a table showing an overview of the current turbine noise settings and the time when they were entered and verified in the turbines. Also a table with SCADA settings has been added to this document.

On the last page in the document you will find a screenshot showing the SCADA settings for the Sector Wind Direction Pause system, which is part of the noise mitigation strategy.

Updated Friday, 06 March 2015: short description of VTM Turbine Parameter Monitoring on page 8

Yours sincerely
Lars Peter Hansen
Engineering Northern Hub
Global Service, EMEA

Turbine mitigation strategy:

Turbine ID	Generator strategy	Mitigation Sector Parameters for NRMS	Date and time for the implementation of Mitigation Strategy dd-mm-yyyy hh:mm:ss	Initials
41307/WTG01	Delta mode only	Turbine 1 / Sector 1 / Sector 2 Operational Mode Required: 6 / 3 Min Wind Speed: 5,3 / 11,2 Max Wind Speed: 11,2 / 14,0 Min Wind Direction: 0 / 0 Max Wind Direction: 270 / 270 Overall Time Period: 0700 - 2300	14-01-2015 10:30:18	LPH
41308/WTG02	Delta mode only	Turbine 2 / Sector 1 / Sector 2 Operational Mode Required: 1 / 6 Min Wind Speed: 5,3 / 5,3 Max Wind Speed: 14,0 / 14,0 Min Wind Direction: 0 / 90 Max Wind Direction: 90 / 180 Overall Time Period: 24/7	19-01-2015 07:00:25	LPH
41309/WTG03	Delta mode only	Turbine 3 / Sector 1 / Sector 2 Operational Mode Required: 4 / 4 Min Wind Speed: 7,3 / 3,3 Max Wind Speed: 16,8 / 16,8 Min Wind Direction: 0 / 180 Max Wind Direction: 180 / 0 Overall Time Period: 0700-2300	13-01-2015 11:51:11	LPH
41310/WTG04	Delta mode only	Turbine 4 / Sector 1 / Sector 2 Operational Mode Required: 6 / 4 Min Wind Speed: 3,3 / 10,3 Max Wind Speed: 10,3 / 17,3 Min Wind Direction: all directions / all directions Max Wind Direction: all directions / all directions Overall Time Period: 24/7	13-01-2015 12:45:00	LPH
41311/WTG05	Delta mode only	Turbine 5 / Sector 1 / Sector 2 Operational Mode Required: N/A / N/A Min Wind Speed: N/A / N/A Max Wind Speed: N/A / N/A Min Wind Direction: N/A / N/A Max Wind Direction: N/A / N/A Overall Time Period: N/A	13-01-2015 08:07:48	LPH
41312/WTG06	Delta mode only	Turbine 6 / Sector 1 / Sector 2 Operational Mode Required: 6 / 4 Min Wind Speed: 3,3 / 10,3 Max Wind Speed: 10,3 / 17,3 Min Wind Direction: all directions / all directions Max Wind Direction: all directions / all directions Overall Time Period: 24/7	13-01-2015 12:52:50	LPH
41313/WTG07	Delta mode only	Turbine 7 / Sector 1 / Sector 2 Operational Mode Required: 6 / 2 Min Wind Speed: 5,3 / 5,3 Max Wind Speed: 15,5 / 14,0 Min Wind Direction: 270 / 90 Max Wind Direction: 90 / 270 Overall Time Period: 24/7	13-01-2015 08:57:28	LPH
41314/WTG08	Delta mode only	Turbine 8 / Sector 1 / Sector 2 Operational Mode Required: N/A / N/A Min Wind Speed: N/A / N/A Max Wind Speed: N/A / N/A Min Wind Direction: N/A / N/A Max Wind Direction: N/A / N/A Overall Time Period: N/A	13-01-2015 09:05:21	LPH
41315/WTG09	Delta mode only	Turbine 9 / Sector 1 / Sector 2 Operational Mode Required: 6 / 4 Min Wind Speed: 3,3 / 3,3 Max Wind Speed: 3,3 / 17,3 Min Wind Direction: 180 / 180 Max Wind Direction: 90 / 90 Overall Time Period: 24/7	13-01-2015 09:21:27	LPH

Turbine ID	Generator strategy	Mitigation Sector Parameters for NRMS	Date and time for the implementation of Mitigation Strategy dd-mm-yyyy hh:mm:ss	Initials
41316/WTG10	Delta mode only	Turbine 10 / Sector 1 / Sector 2 Operational Mode Required: 6 / 4 Min Wind Speed: 3,9 / 9,2 Max Wind Speed: 9,2 / 17,3 Min Wind Direction: all directions / all directions Max Wind Direction: all directions / all directions Overall Time Period: 24/7	13-01-2015 13:53:17	LPH
41317/WTG11	Delta mode only	Turbine 11 / Sector 1 / Sector 2 Operational Mode Required: 6 / 4 Min Wind Speed: 3,9 / 9,2 Max Wind Speed: 9,2 / 17,3 Min Wind Direction: all directions / all directions Max Wind Direction: all directions / all directions Overall Time Period: 24/7	13-01-2015 13:06:57	LPH
41318/WTG12	Delta mode only	Turbine 12 / Sector 1 / Sector 2 Operational Mode Required: 4 / 3 Min Wind Speed: 3,9 / 5,3 Max Wind Speed: 17,3 / 14,0 Min Wind Direction: 180 / 90 Max Wind Direction: 90 / 180 Overall Time Period: 24/7	13-01-2015 10:25:19	LPH
41319/WTG13	Delta mode only	Turbine 13 / Sector 1 / Sector 2 Operational Mode Required: 6 / 4 Min Wind Speed: 3,9 / 9,2 Max Wind Speed: 9,2 / 17,3 Min Wind Direction: all directions / all directions Max Wind Direction: all directions / all directions Overall Time Period: 24/7	13-01-2015 13:20:19	LPH
41320/WTG14	Delta mode only	Turbine 14 / Sector 1 / Sector 2 Operational Mode Required: 4 / 3 Min Wind Speed: 3,9 / 7,3 Max Wind Speed: 17,3 / 12,4 Min Wind Direction: 180 / 90 Max Wind Direction: 90 / 180 Overall Time Period: 24/7	13-01-2015 10:56:33	LPH
41321/WTG15	Delta mode only	Turbine 15 / Sector 1 / Sector 2 Operational Mode Required: 3 / 4 Min Wind Speed: 5,3 / 8,6 Max Wind Speed: 8,6 / 17,3 Min Wind Direction: 0 / all directions Max Wind Direction: 270 / all directions Overall Time Period: 24/7	13-01-2015 13:38:40	LPH
41322/WTG16	Delta mode only	Turbine 16 / Sector 1 / Sector 2 Operational Mode Required: 3 / 4 Min Wind Speed: 5,3 / 7,4 Max Wind Speed: 7,4 / 17,3 Min Wind Direction: 90 / all directions Max Wind Direction: 0 / all directions Overall Time Period: 24/7	13-01-2015 12:08:23	LPH
41323/WTG17	Delta mode only	Turbine 17 / Sector 1 / Sector 2 Operational Mode Required: 3 / 4 Min Wind Speed: 5,3 / 8,6 Max Wind Speed: 8,6 / 17,3 Min Wind Direction: 90 / all directions Max Wind Direction: 0 / all directions Overall Time Period: 24/7	13-01-2015 12:23:19	LPH
41324/WTG18	Delta mode only	Turbine 18 / Sector 1 / Sector 2 Operational Mode Required: 6 / 4 Min Wind Speed: 5,3 / 9,2 Max Wind Speed: 9,2 / 17,3 Min Wind Direction: all directions / all directions Max Wind Direction: all directions / all directions Overall Time Period: 24/7	13-01-2015 12:39:04	LPH
41325/WTG19	Delta mode only	Turbine 19 / Sector 1 / Sector 2 Operational Mode Required: 6 / 4 Min Wind Speed: 5,3 / 8,6 Max Wind Speed: 8,6 / 17,3 Min Wind Direction: 180 / 180 Max Wind Direction: 90 / 90 Overall Time Period: 24/7	14-01-2015 07:09:46	LPH

<table>
<tr><th>Turbine ID</th><th>Generator strategy</th><th>Mitigation Sector Parameters for NRMS</th><th>Date and time for the implementation of Mitigation Strategy dd-mm-yyyy hh:mm:ss</th><th>Initials</th></tr>
<tr><td>41326/WTG20</td><td>Delta mode only</td><td>
<table>
<tr><td>Turbine 20</td><td>Sector 1</td><td>Sector 2</td></tr>
<tr><td>Operational Mode Required</td><td>6</td><td>4</td></tr>
<tr><td>Min Wind Speed</td><td>5,3</td><td>8,6</td></tr>
<tr><td>Max Wind Speed</td><td>8,6</td><td>17,3</td></tr>
<tr><td>Min Wind Direction</td><td>270</td><td>all directions</td></tr>
<tr><td>Max Wind Direction</td><td>180</td><td>all directions</td></tr>
<tr><td>Overall Time Period</td><td colspan="2">24/7</td></tr>
</table>
</td><td>14-01-2015 07:33:27</td><td>LPH</td></tr>
<tr><td>41327/WTG21</td><td>Delta mode only</td><td>
<table>
<tr><td>Turbine 21</td><td>Sector 1</td><td>Sector 2</td></tr>
<tr><td>Operational Mode Required</td><td>6</td><td>4</td></tr>
<tr><td>Min Wind Speed</td><td>5,3</td><td>8,6</td></tr>
<tr><td>Max Wind Speed</td><td>8,6</td><td>17,3</td></tr>
<tr><td>Min Wind Direction</td><td>270</td><td>all directions</td></tr>
<tr><td>Max Wind Direction</td><td>180</td><td>all directions</td></tr>
<tr><td>Overall Time Period</td><td colspan="2">24/7</td></tr>
</table>
</td><td>14-01-2015 08:18:06</td><td>LPH</td></tr>
<tr><td>41328/WTG22</td><td>Delta mode only</td><td>
<table>
<tr><td>Turbine 22</td><td>Sector 1</td><td>Sector 2</td></tr>
<tr><td>Operational Mode Required</td><td>4</td><td>N/A</td></tr>
<tr><td>Min Wind Speed</td><td>7,3</td><td>N/A</td></tr>
<tr><td>Max Wind Speed</td><td>17,3</td><td>N/A</td></tr>
<tr><td>Min Wind Direction</td><td>180</td><td>N/A</td></tr>
<tr><td>Max Wind Direction</td><td>90</td><td>N/A</td></tr>
<tr><td>Overall Time Period</td><td colspan="2">24/7</td></tr>
</table>
</td><td>14-01-2015 08:38:22</td><td>LPH</td></tr>
</table>

SCADA mitigation strategy:

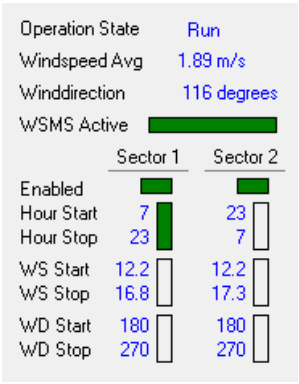
SCADA system	VOB	Initials
Park title	Fullabrook	
Country	United Kingdom	
WSMS developed	Week 2 and 3	CHJ
WSMS tested finished	21-01-2015	CHJ
WSMS Start-up date	21-01-2015	CHJ

<table>
<tr><th>Turbine ID</th><th>Sector Wind Direction Pause system From SCADA</th><th>Date and time for the implementation of Mitigation Strategy dd-mm-yyyy hh:mm</th><th>Initials</th></tr>
<tr><td>41317/WTG11</td><td>
<table>
<tr><td></td><td>Shut Down 1</td><td>Shut Down 2</td></tr>
<tr><td>Min Wind Speed</td><td>12,2</td><td>-</td></tr>
<tr><td>Max Wind Speed</td><td>17,3</td><td>-</td></tr>
<tr><td>Min Wind Direction</td><td>270</td><td>-</td></tr>
<tr><td>Max Wind Direction</td><td>0</td><td>-</td></tr>
<tr><td>Time Period</td><td>2300-0700</td><td>-</td></tr>
</table>
</td><td>21-01-2015 15:00</td><td>C HJ</td></tr>
<tr><td>41319/WTG13</td><td>
<table>
<tr><td></td><td>Shut Down 1</td><td>Shut Down 2</td></tr>
<tr><td>Min Wind Speed</td><td>12,2</td><td>-</td></tr>
<tr><td>Max Wind Speed</td><td>17,3</td><td>-</td></tr>
<tr><td>Min Wind Direction</td><td>270</td><td>-</td></tr>
<tr><td>Max Wind Direction</td><td>0</td><td>-</td></tr>
<tr><td>Time Period</td><td>2300-0700</td><td>-</td></tr>
</table>
</td><td>21-01-2015 15:00</td><td>C HJ</td></tr>
<tr><td>41322/WTG16</td><td>
<table>
<tr><td></td><td>Shut Down 1</td><td>Shut Down 2</td></tr>
<tr><td>Min Wind Speed</td><td>12,2</td><td>-</td></tr>
<tr><td>Max Wind Speed</td><td>16,8</td><td>-</td></tr>
<tr><td>Min Wind Direction</td><td>180</td><td>-</td></tr>
<tr><td>Max Wind Direction</td><td>270</td><td>-</td></tr>
<tr><td>Time Period</td><td>0700-2300</td><td>-</td></tr>
</table>
</td><td>21-01-2015 15:00</td><td>C HJ</td></tr>
<tr><td>41324/WTG18</td><td>
<table>
<tr><td></td><td>Shut Down 1</td><td>Shut Down 2</td></tr>
<tr><td>Min Wind Speed</td><td>8,2</td><td>-</td></tr>
<tr><td>Max Wind Speed</td><td>12,4</td><td>-</td></tr>
<tr><td>Min Wind Direction</td><td>0</td><td>-</td></tr>
<tr><td>Max Wind Direction</td><td>90</td><td>-</td></tr>
<tr><td>Time Period</td><td>0700-2300</td><td>-</td></tr>
</table>
</td><td>21-01-2015 15:00</td><td>C HJ</td></tr>
</table>

<table>
<tr><th>Turbine ID</th><th>Sector Wind Direction Pause system From SCADA</th><th>Date and time for the implementation of Mitigation Strategy
dd-mm-yyyy hh:mm</th><th>Initials</th></tr>
<tr><td>41326/WTG20</td><td>
<table>
<tr><th></th><th>Shut Down 1</th><th>Shut Down 2</th></tr>
<tr><td>Min Wind Speed</td><td>8,2</td><td>-</td></tr>
<tr><td>Max Wind Speed</td><td>12,4</td><td>-</td></tr>
<tr><td>Min Wind Direction</td><td>0</td><td>-</td></tr>
<tr><td>Max Wind Direction</td><td>90</td><td>-</td></tr>
<tr><td>Time Period</td><td>0700-2300</td><td>-</td></tr>
</table>
</td><td>21-01-2015 15:00</td><td>C HJ</td></tr>
<tr><td>41327/WTG21</td><td>
<table>
<tr><th></th><th>Shut Down 1</th><th>Shut Down 2</th></tr>
<tr><td>Min Wind Speed</td><td>5,3</td><td>10,9</td></tr>
<tr><td>Max Wind Speed</td><td>12,4</td><td>16,8</td></tr>
<tr><td>Min Wind Direction</td><td>0</td><td>180</td></tr>
<tr><td>Max Wind Direction</td><td>90</td><td>270</td></tr>
<tr><td>Time Period</td><td>0700-2300</td><td>0700-2300</td></tr>
</table>
</td><td>21-01-2015 15:00</td><td>C HJ</td></tr>
<tr><td>41328/WTG22</td><td>
<table>
<tr><th></th><th>Shut Down 1</th><th>Shut Down 2</th></tr>
<tr><td>Min Wind Speed</td><td>12,2</td><td>12,2</td></tr>
<tr><td>Max Wind Speed</td><td>16,8</td><td>17,3</td></tr>
<tr><td>Min Wind Direction</td><td>180</td><td>180</td></tr>
<tr><td>Max Wind Direction</td><td>270</td><td>270</td></tr>
<tr><td>Time Period</td><td>0700-2300</td><td>2300-0700</td></tr>
</table>
</td><td>21-01-2015 15:00</td><td>C HJ</td></tr>
</table>

Explanation to the SCADA WSMS picture:

When the defined criteria in a sector are met, the turbine operation state is changed to Pause. The entry in the alarm log will read “Paused by source 6” (Environmental). All three different criteria will have to be met in order to pause the turbine. If one of the criteria is no longer met the turbine will be put back into production.



- Operation State: Tells what state the turbine is in. (Run = in Production)
- Windspeed Avg: Is the filtered and averaged wind speed signal used by the WSMS
- Winddirection: Is the filtered nacelle position signal used by the WSMS
- WSMS active: Green means that the sector wind direction system is activated
- Enabled: Green tells how many sectors that are used
- Criteria 1: Hour start and Hour stop: If the time is in between the start and stop hour, the frame is green and one of three criteria is met.
- Criteria 2: WS Start and WS stop: If the Wind speed Avg. is in between the start and stop speed, the frame is green and the second out of three criteria is met.
- Criteria 3: WD Start and WD stop: If the Wind direction is in between the start and stop position, the frame is green and the third out of three criteria is met.

- The clock used by the WSMS: The time used is the local time zone

How to check the status of WSMS:

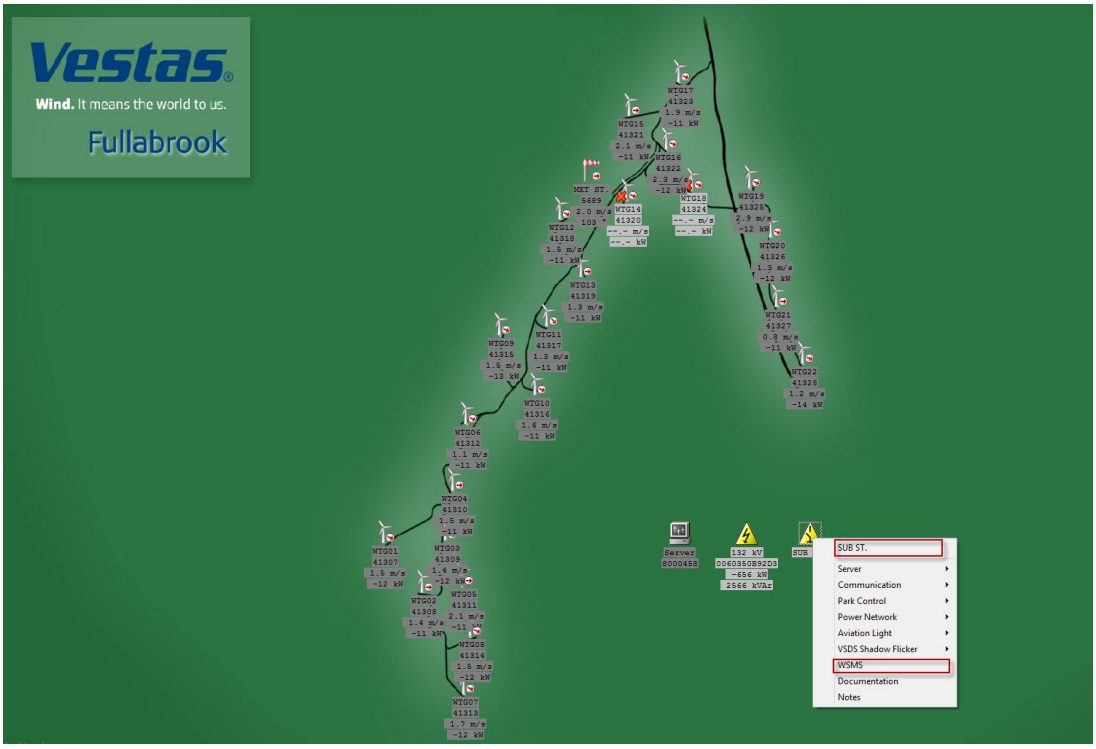


Figure 1 It is visible on the SCADA system by right clicking on the SUB ST icon and choosing WSMS.

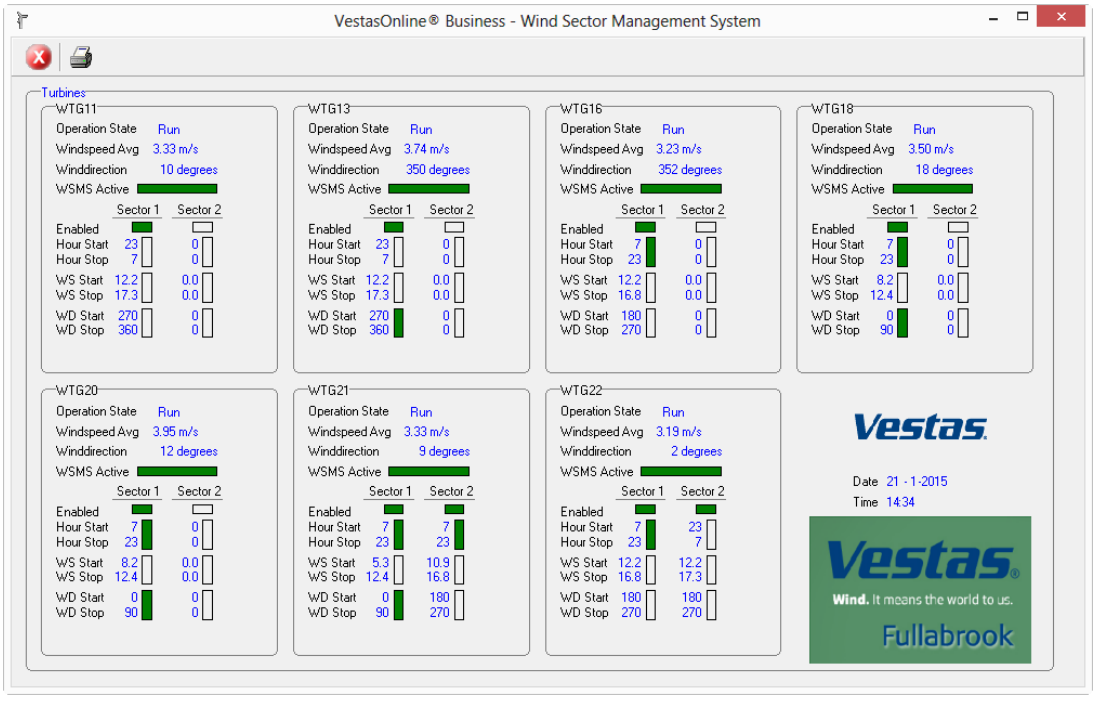


Figure 2 Status WSMS picture

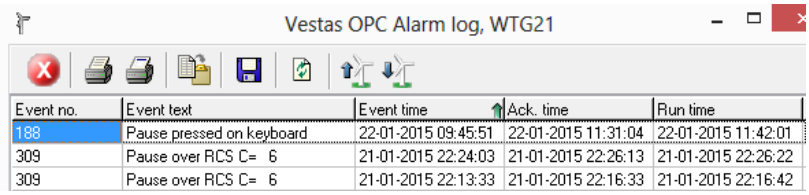


Figure 3 Example from a turbine log where the turbine is paused from the SCADA/WSMS system

VTM Turbine Parameter Monitoring

Turbine Parameter Monitoring is an internal Vestas' tool which allows Vestas to monitor self-selected parameter on individual turbines.
The monitor checks turbine parameter up against a reference database.
The reference database is maintained by Technical Field Support in the regions.
The reference database for Fullabrook wind farm contains noise setting and generator operation mode for all turbines.
The turbine parameter values are supplied from two different sources to the Vestas Database

1. If any Vestas computer makes change to a turbine configuration, it is sending the new configuration to Vestas Database afterwards.
2. The customers SCADA system collects turbine parameter and transfer the data to Vestas Database on a daily basis.

If selected turbine parameter is different from parameters in reference database, the monitor generates an alert, which is visible to all VTM users at Vestas.
Responsibility for handling alerts from the parameter monitor is the Regions / Technical Field Support department.
Extraordinarily our VTM Specialist will develop an automated status message that will be sent by email to the Vestas customer service manager for Fullabrook with an interval of every quarter or half-year.

From: VWSVDCSupport@vestas.com [mailto:VWSVDCSupport@vestas.com]
Sent: 5. marts 2015 12:32
To: Lars Peter Hansen
Subject: Fullabrook Parameter Alerts.rdl was executed at 3/5/2015 12:32:05 PM

VTM Parameter status

	Fullabrook																					
Parameter Name	41307	41308	41309	41310	41311	41312	41313	41314	41315	41316	41317	41318	41319	41320	41321	41322	41323	41324	41325	41326	41327	41328
ConnectPitchPosPx (VMP6000)																						
FreewheelPositionPx (VMP6000)																						
Gen1PowerMinPx (VMP6000)																						
GeneratorSelectPx (VMP6000)																						
NRMSSec1EndPx (VMP6000)																						

Figure 4 example of a status messages from Turbine Parameter Monitor

Green frame means that the reference database parameter and the actual turbine parameter have an identical value.

White frame means that this parameter the specific turbine is not monitored.

Red frame means that there is a difference in the parameter value between reference database and actual turbine parameter value