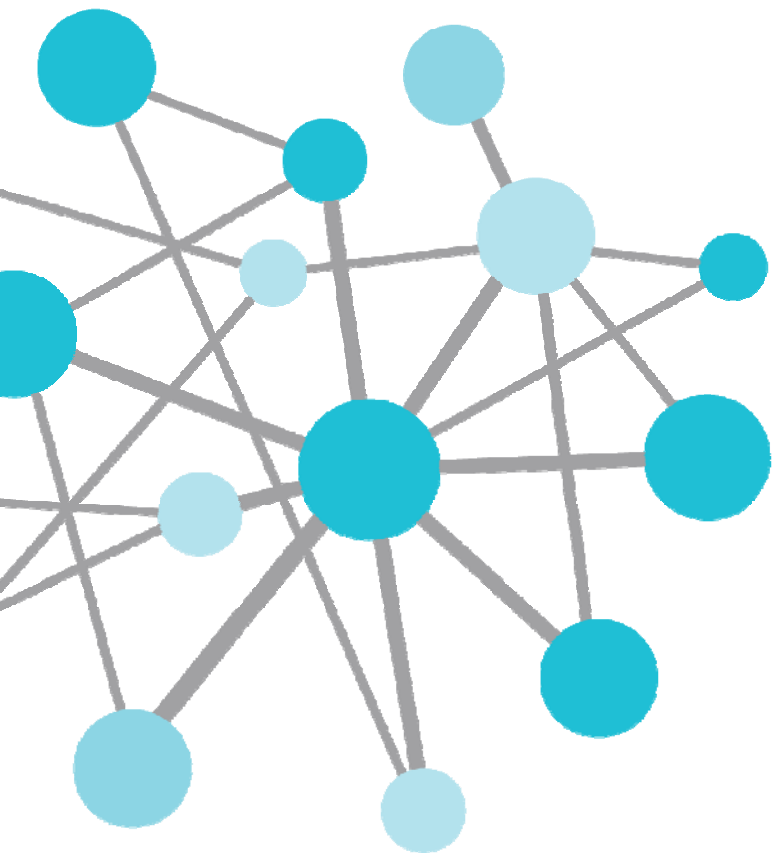




Leveraging Technology to Optimise Operations and Maintenance

Presented by **Henrico van Niekerk – Meridian Energy**
David Barker – Dimension Software



meridian





Who is Meridian Energy?

- New Zealand-based power generation company
- 7 hydro power stations (over 2GW total)
- 5 wind farm power stations in NZ
- 2 wind farm power stations in AUS
- Had PI for hydro sites since late 1990's
- Two Vestas and two Siemens sites in PI
- 174 turbines



meridian

Project Overview

- Give us more information!
- PI for Wind
 - Central one stop shop for data from multiple sources
 - Scale over multiple wind farms
 - Backfill historical data
 - Integrate with existing hydro data
 - Graphical User Interface
 - Information available
 - Correlate data



meridian

Our Requirements

- Storing and downloading data
- Analysing events
- Monitoring components
- Reporting on KPIs.



Drivers and Goals for the Project

- Predict component faults, giving suitable lead times before failure
- Prevent component faults, through the identification and implementation of plant Engineering changes
- Improve turbine efficiency.
- Displays to make the information easier to understand.



Plant Information Portal

Home Hydro Wind

This Site



Plant Information Portal Overview

Assets

Hydro

Meridian Overview

Hydrologist

Manapouri

Manapouri Hydraulic Syst

Manapouri Maximo Temp

MLC & TLC Gates

Station Diagnostics MAN

Mid Waitaki Overview

Aviemore

Benmore

Mid Waitaki Hydraulic Sys

Waitaki

Ohau Overview

Ohau A

Ohau B

Ohau C

Ohau C Maximo Temp

Station Diagnostics OH

Ohau Hydraulic System

Wind

Te Uku

String 1

String 2

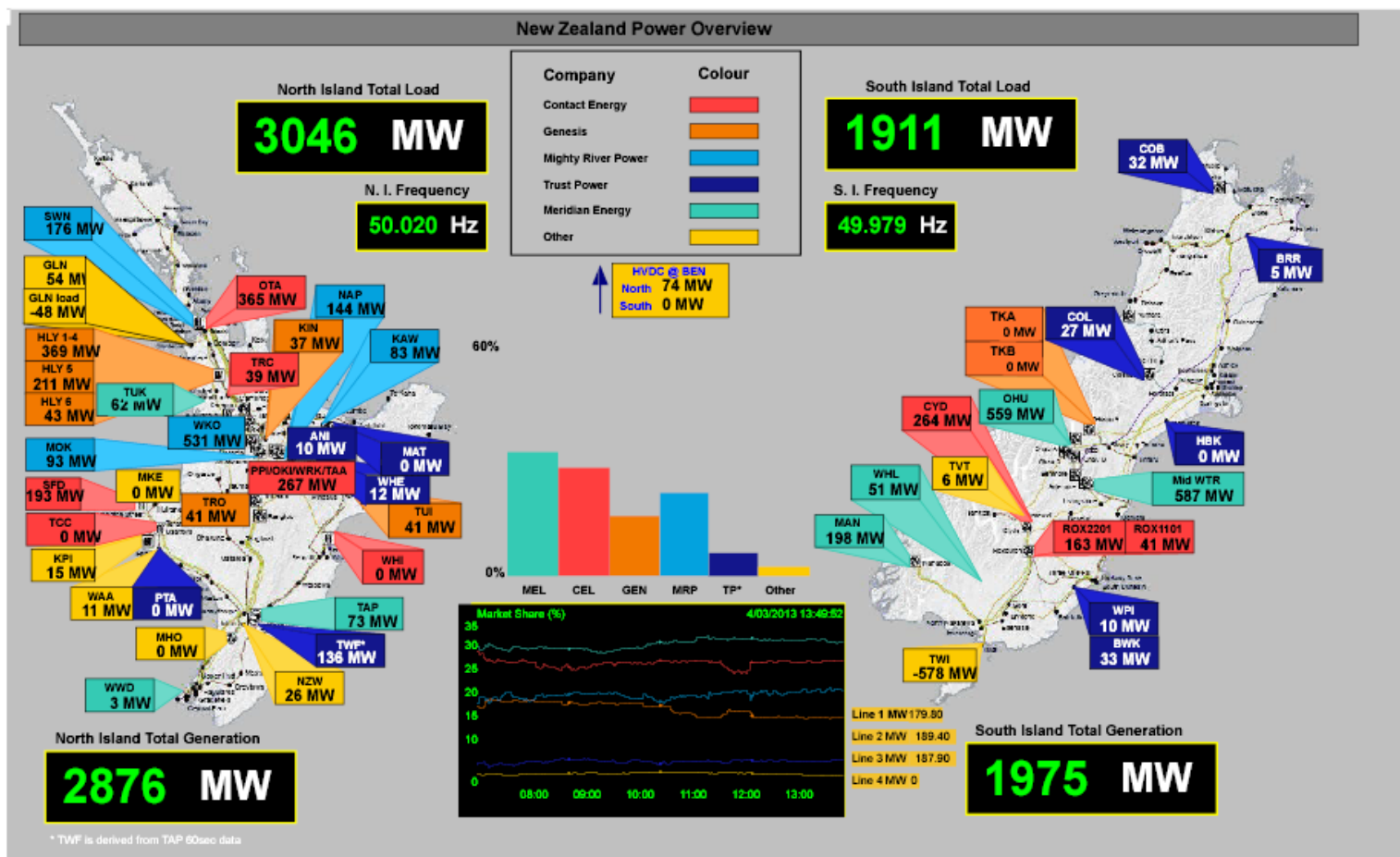
String 3

West Wind

String 1

String 2

String 3



WindFarms

- Alarm Log
- Monitoring
- Potential Revenue
- TAP
- TUK
- WHL
- WWD
- Grid
- Meteorology
- Potential Revenue
- Turbines
 - 101
 - 102
 - 103
 - 104
 - 105
 - 106
 - 107
 - 108
 - 109
 - 110
 - 201
 - 202
 - 203
 - 204
 - 205
 - 206
 - 207
 - 208
 - 209
 - 210
 - 301
 - 302
 - 303
 - 304
 - 305
 - 306

> Latest 10 alarms:

Code	From	To	Station	Description	Alarm Type	Group
393	04/03/2013 12:26:09		TAP48	Vibration TAC84	Alarm	Overspeed or Overproduction
393	04/03/2013 12:14:41		TAP49	Vibration TAC84	Alarm	Overspeed or Overproduction
393	04/03/2013 12:09:12	04/03/2013 12:14:27	TAP22	Vibration TAC84	Alarm	Overspeed or Overproduction
10105	04/03/2013 11:57:43	04/03/2013 12:07:06	WWD604	Stopped, untwisting cables	Alarm	Yaw System
7111	04/03/2013 11:45:29	04/03/2013 11:45:53	WWD409	Hyd. for crane/cover activated	Alarm	Hydraulic System

	Turbines	Available	Running	Auto Reset	Manual Reset	Service Mode	No Comms
TUK	28	28	28	3	0	0	0
TAP	55	54		0			
WWD	62	56	50	2	0	5	1
WHL	29		29	0		0	0

POWER PRODUCTION

TE UKU **61.1 MW**

REACTIVE POWER: -7.4 MVar

WIND SPEED: 12.7 m/s

TE APITI **72.9 MW**

REACTIVE POWER: -1.9 MVar

WIND SPEED: 7.5 m/s

WEST WIND **8.3 MW**

REACTIVE POWER: 3.6 MVar

WIND SPEED: 4.8 m/s

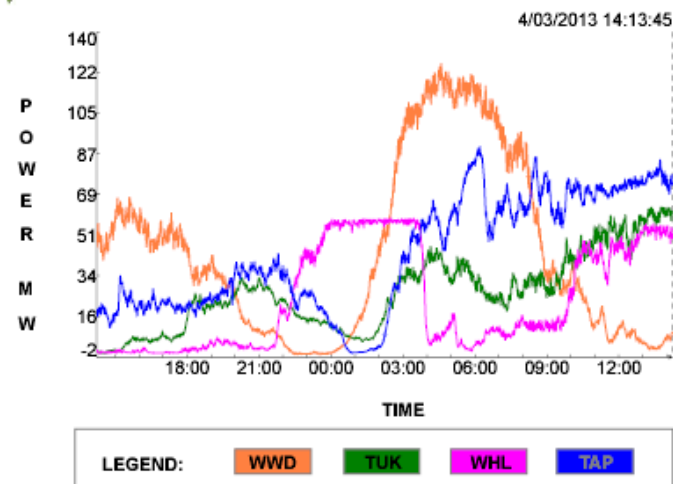
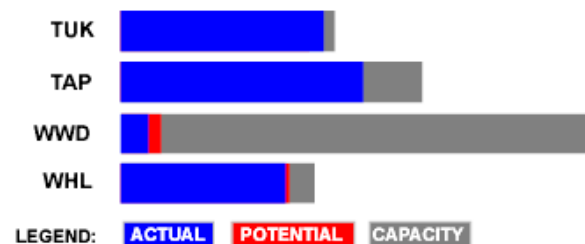
WHITE HILL **49.5 MW**

REACTIVE POWER: -0.7 MVar

WIND SPEED: 14.3 m/s

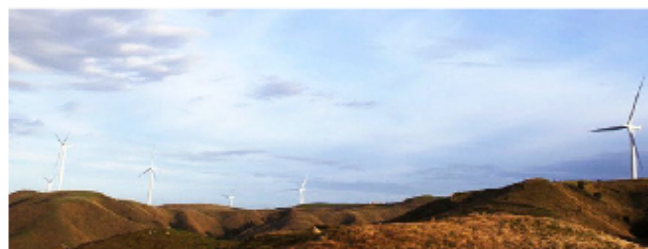


POWER PRODUCTION - MW



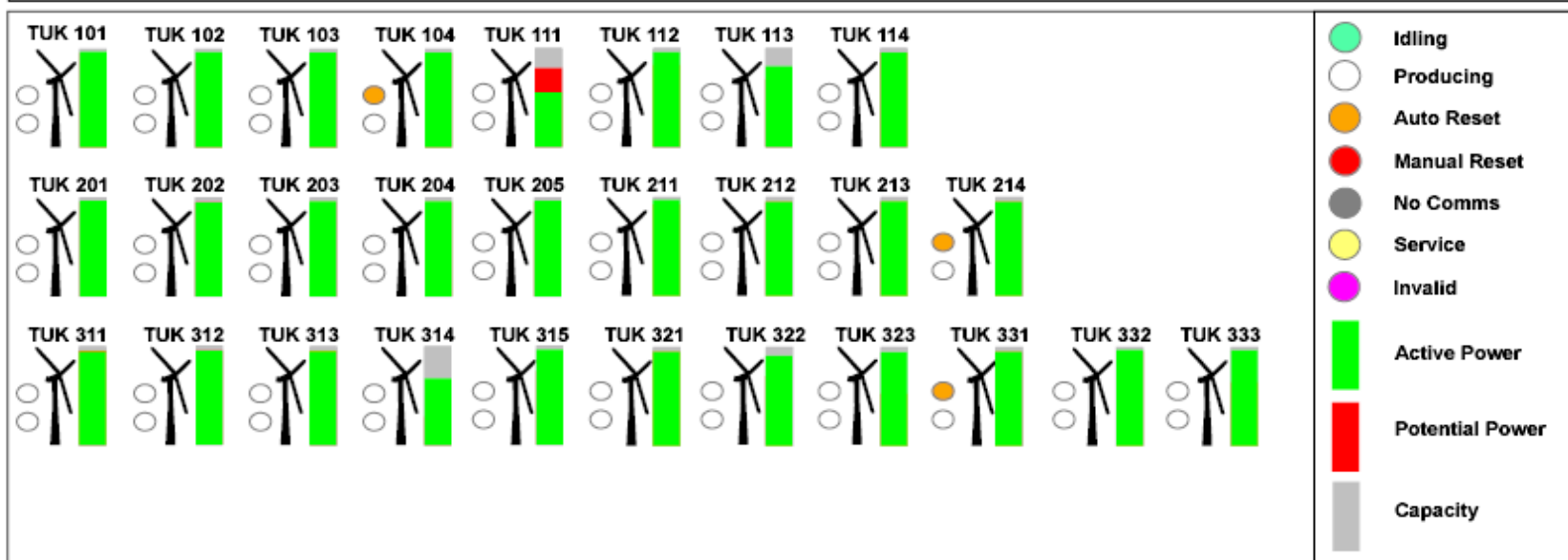
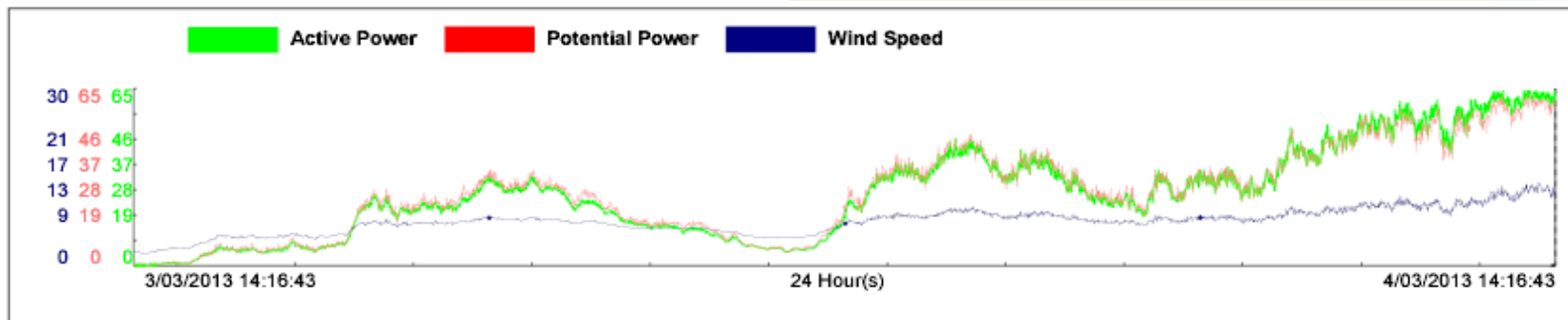
> Latest 10 alarms:

Code	From	To	Station	Description	Alarm Type	Group
7111	04/03/2013 11:18:30	04/03/2013 11:18:41	TUK321	Hyd. for crane/cover activated	Alarm	Hydraulic System
1001	04/03/2013 11:17:41	04/03/2013 11:27:13	TUK321	Manual stop	Alarm	Manual Command
1015	04/03/2013 11:16:40	04/03/2013 11:27:07	TUK321	Manual idle stop	Alarm	Manual Command
7111	04/03/2013 11:04:48	04/03/2013 11:04:57	TUK321	Hyd. for crane/cover activated	Alarm	Hydraulic System
1001	04/03/2013 10:57:13	04/03/2013 11:10:06	TUK321	Manual stop	Alarm	Manual Command



Active Power:	61 MW	Potential Power:	58 MW	
Wind Speed:	11.9 m/s	Wind Direction:	219 Deg	
Turbines Available:	28	Turbines Running:	28	Auto Reset: 3
Manual Reset:	0	Service Mode:	0	No Comms: 0

Active Power:

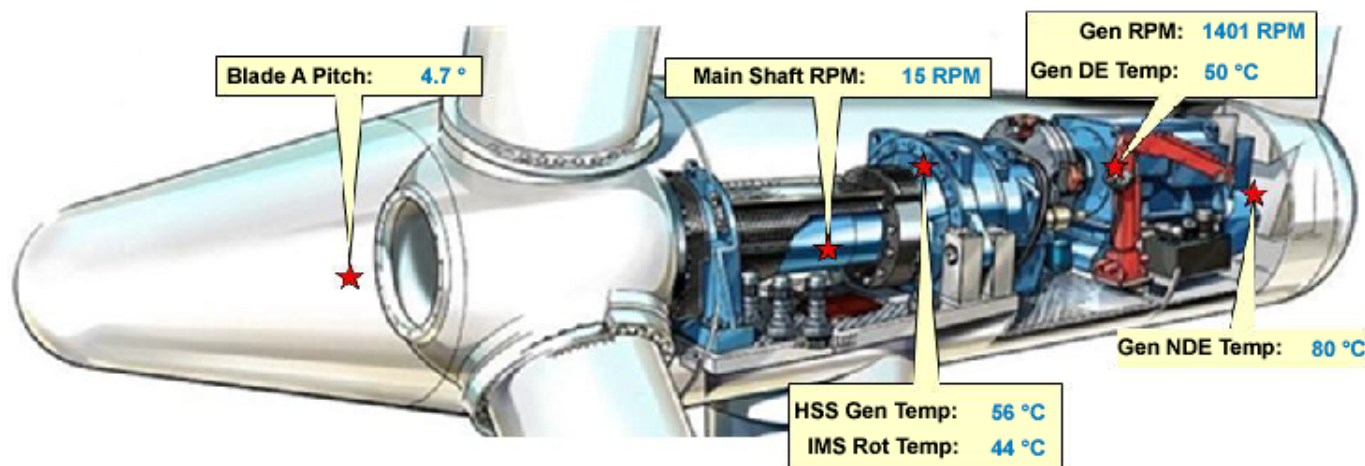
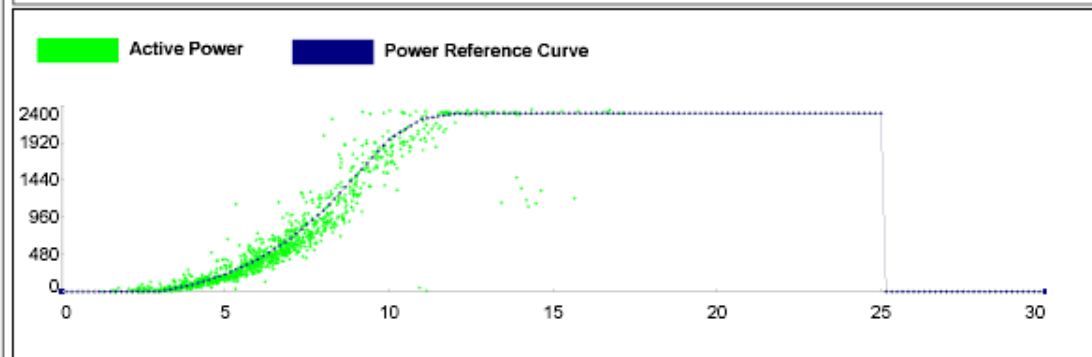
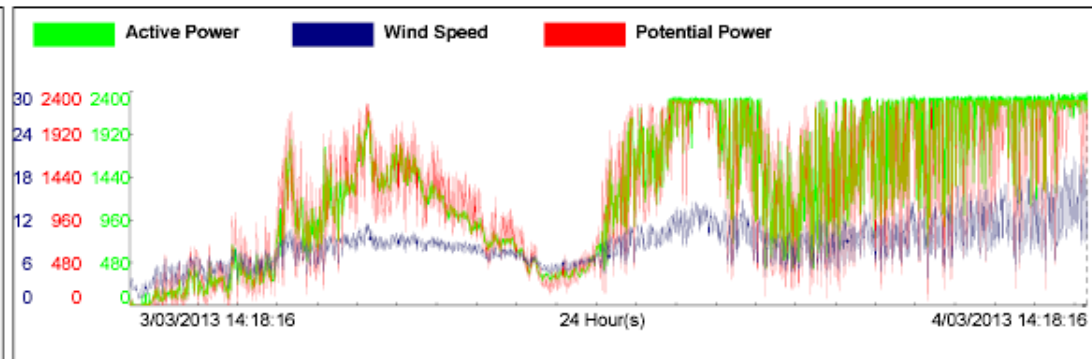


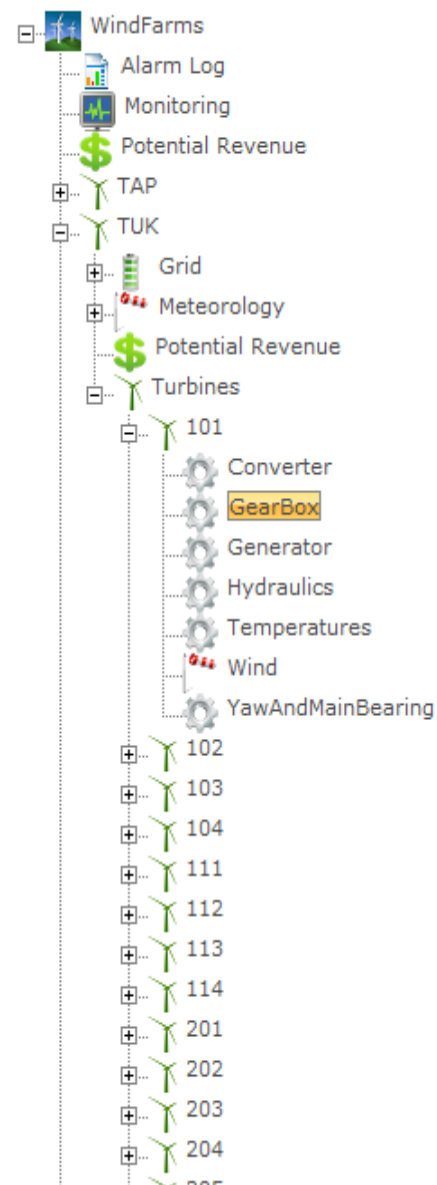
> Latest 10 alarms:

Code	From	To	Station	Description	Alarm Type	Group
10105	03/03/2013 11:14:12	03/03/2013 11:23:26	TUK101	Stopped, untwisting cables	Alarm	Yaw System
5122	01/03/2013 13:24:10	01/03/2013 13:24:10	TUK101	FRT detected by grid module	Warning	Grid
1015	28/02/2013 11:39:58	28/02/2013 12:12:46	TUK101	Manual idle stop	Alarm	Manual Command
1005	28/02/2013 11:39:58	28/02/2013 12:12:47	TUK101	Availability - low wind	Warning	Manual Command
7111	28/02/2013 11:08:44	28/02/2013 11:09:15	TUK101	Hyd. for crane/cover activated	Alarm	Hydraulic System

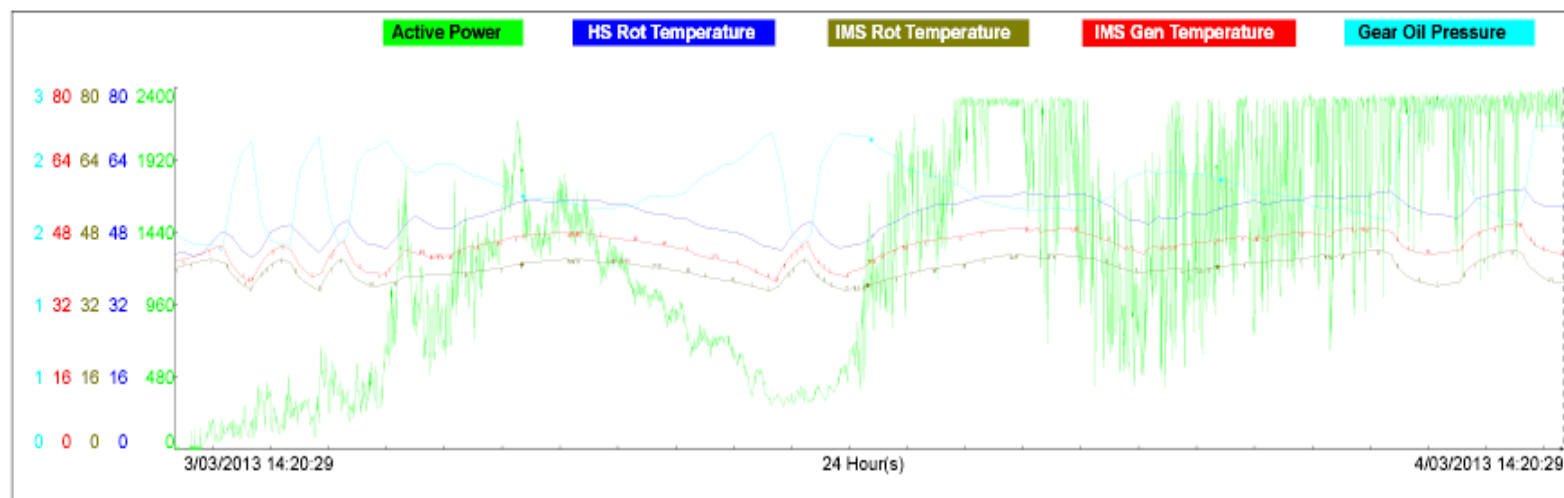
Current Status:

Active Power: 2298 kW
Reactive Power: -146 KVar
Wind Speed: 14.5 m/sec
Yaw Direction: 205 °
Turbine State: InOperation_OnGrid
WPS Status: Faultless
Last Error Code: 0

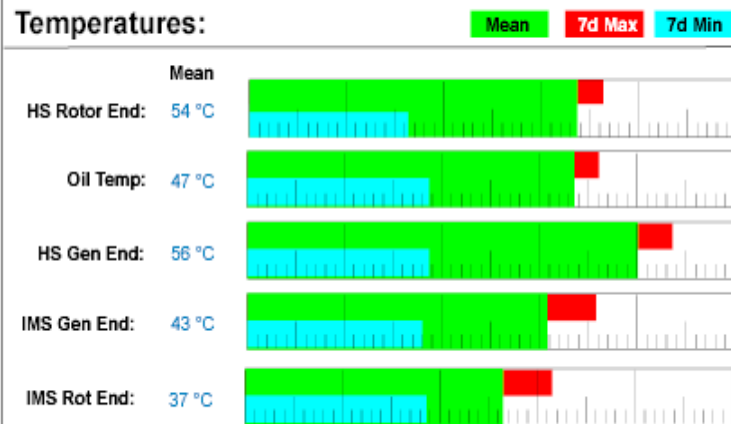




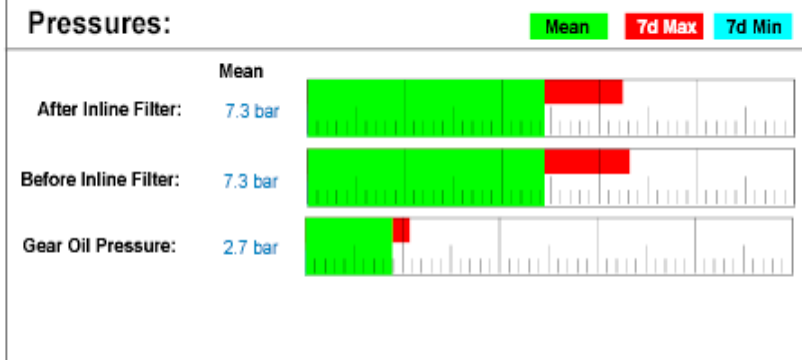
> Latest Alarms



Temperatures:



Pressures:



Handover



About Dimension Software

- Auckland based team of five.
- Specialist **PI Systems Integrator** providing advanced solutions including:
 - Design and project management
 - PI – end to end
 - Software development
 - Analytical engines
 - Bespoke development
 - Customised training

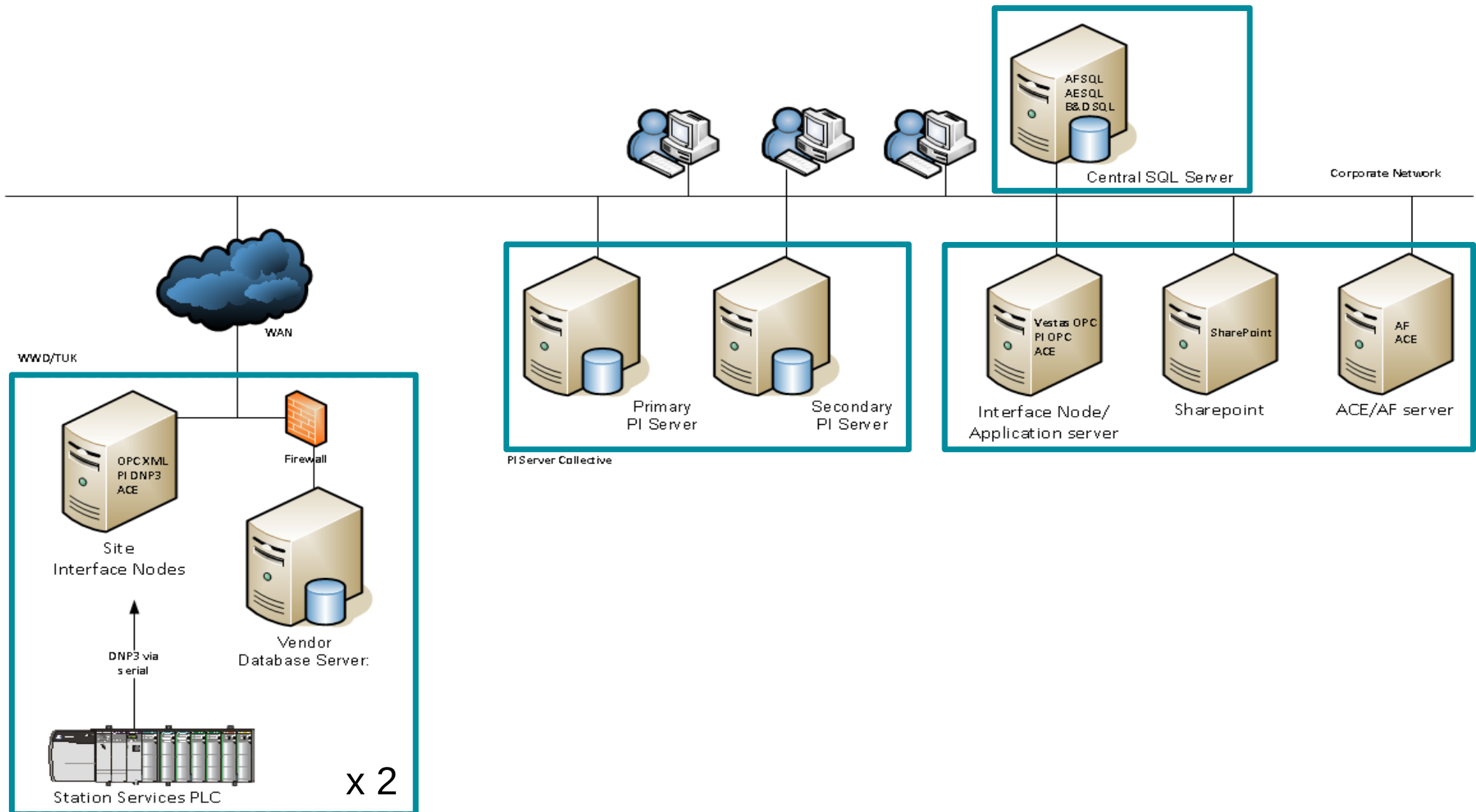


Technical Overview

- Project involved a mixture of **off the shelf** components and custom software **development**
- Spread over a one year period
- Data is **centrally stored** in HA PI servers
- Interfaces collect:
 - **Real-time** data from Siemens & Vestas OPC servers
 - **10 minute** data from site SQL database servers
 - **Alarm and events** from site SQL database servers
 - **Station services** PLC via DNP3 serial
- Additional **68,000** tags



Architecture



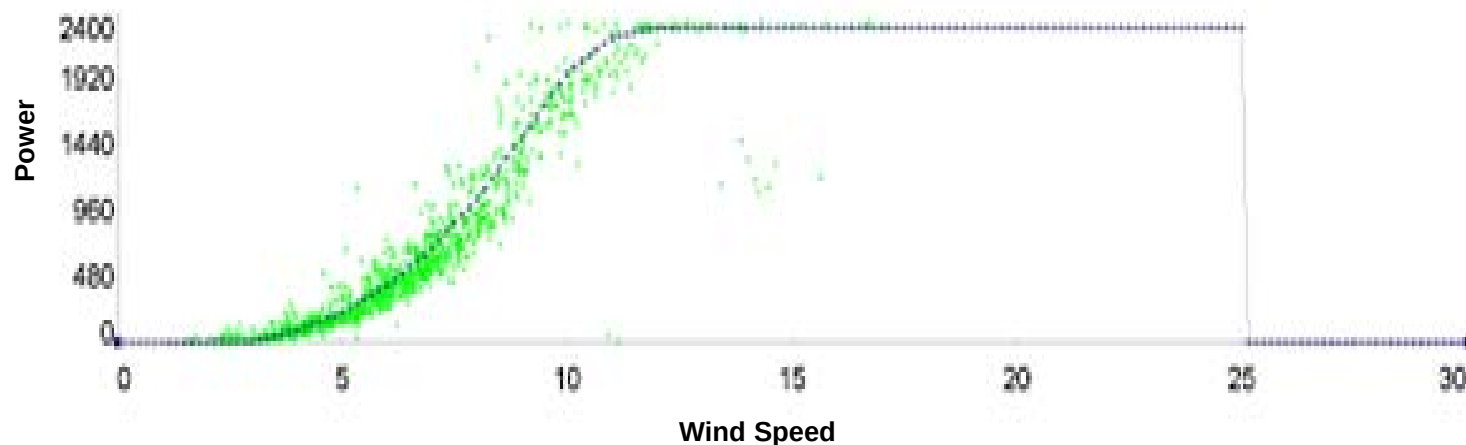
Central Applications

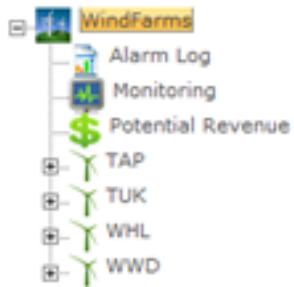
- Central ACE application **collects**:
 - Forecast **wind speed** from MetService
 - Historic, current and forecast **electricity prices** from the market
- Used PI OLEDB COM connector to store forecast data which integrates into PI tags.



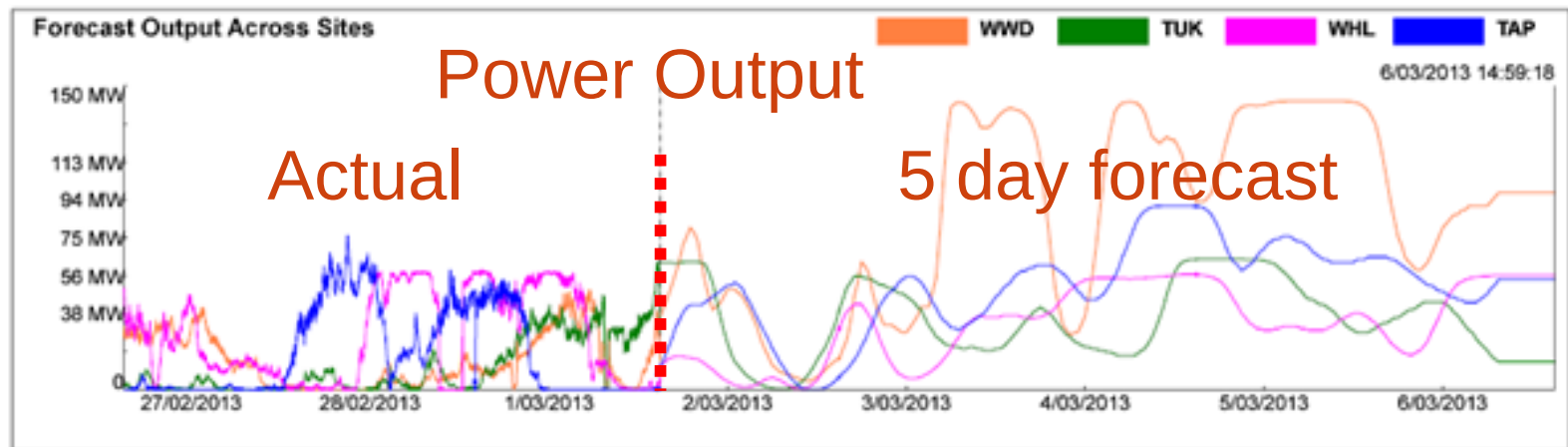
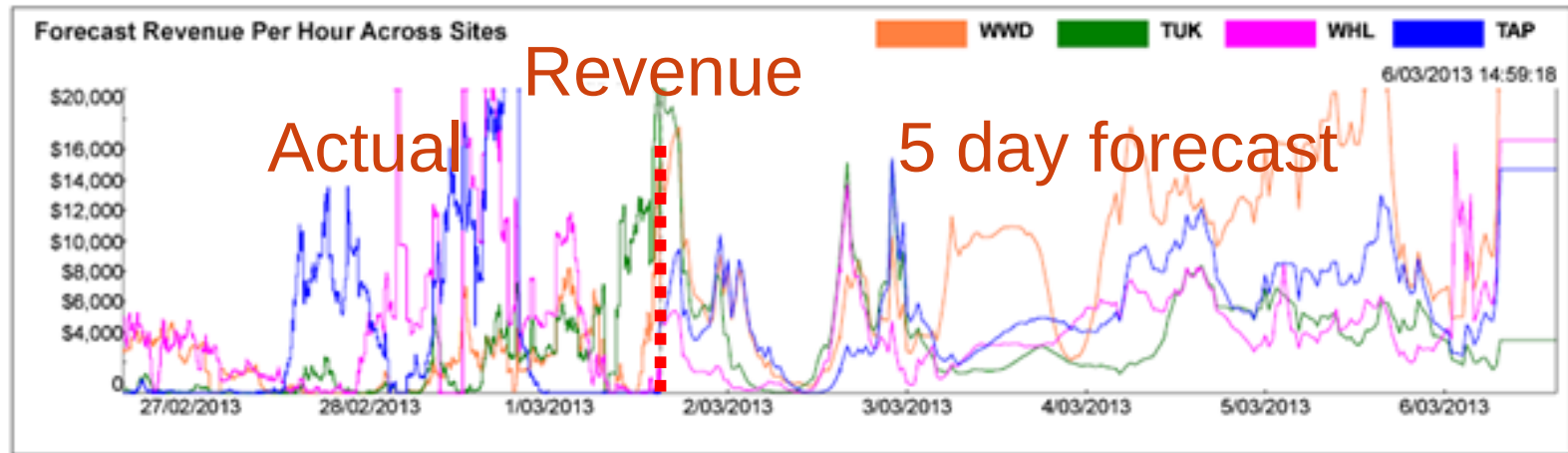
Central Applications

- Central ACE applications **calculate**:
 - Potential power based on capability curve (stored in AF tables)
 - Actual and forecast revenue





	WWD	TUK	TAP	WHL
Current \$/MWh:	\$422.74	\$400.60	\$417.41	\$443.69
Current Output:	16.1 MW	29.2 MW	0.4 MW	4.1 MW
Current Revenue Per Hour:	\$6,810.72	\$11,686.14	\$174.85	\$1,815.98
Current Wind Speed:	5.60 m/s	11.50 m/s	2.90 m/s	2.10 m/s



User Access, Backfill

- **All corporate users** can access the live and historic data via SharePoint, ProcessBook and Excel.
- All historical data **backfilled** starting from 2004 onwards.

Included:

- MS Access
- MS SQL time series data
- MS SQL Alarms and Events.

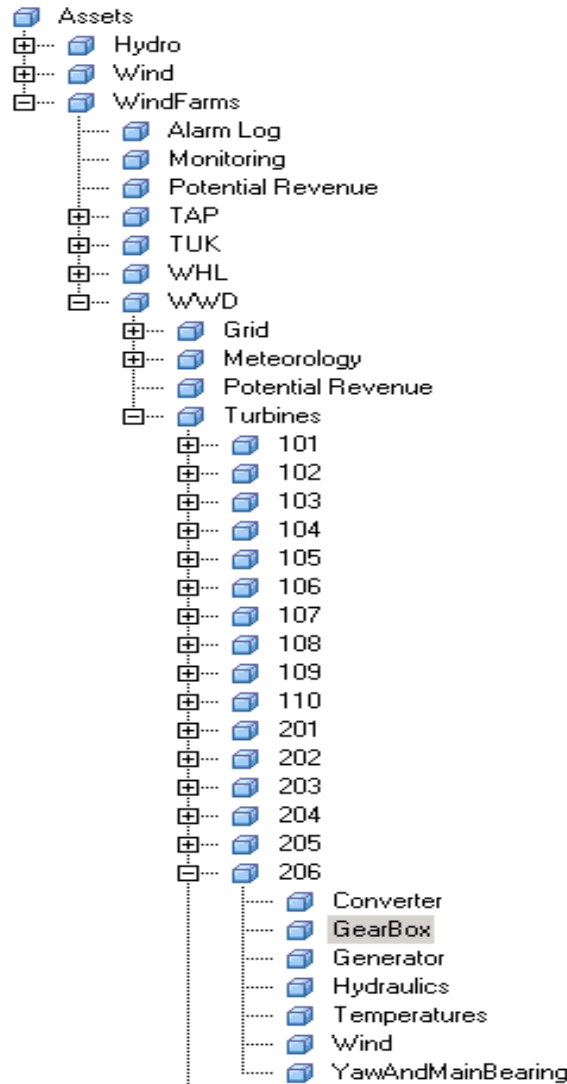
Done via small utilities which directly push to PI via PI-SDK



Asset Framework

- Data organised in an extensive **Asset Framework** database
- Wind turbines are good candidates for AF templates
- 1400 elements
- Calculations and displays are driven by the AF templates.
- **Scale** as new turbines are added.

Asset Framework



Filter		
	Name	Value
	ActivePower	612
	Brake	
	Digitals	
	DisplayName	http://TwZPIWEB2/Shared%;
	Pressures	
	AfterInlineFilter_Max	5.5
	AfterInlineFilter_Max_LastWeek	8.8000001907348633
	AfterInlineFilter_Mean	5.4984498023986816
	AfterInlineFilter_Min	5.4000000953674316
	AfterInlineFilter_Min_LastWeek	0
	BeforeInlineFilter_Max	5.6999998092651367
	BeforeInlineFilter_Max_LastWeek	8.8999996185302734
	BeforeInlineFilter_Mean	5.6118597984313965
	BeforeInlineFilter_Min	5.5999999046325684
	BeforeInlineFilter_Min_LastWeek	0
	GearOilPressure_Max	2
	GearOilPressure_Max_LastWeek	3
	GearOilPressure_Mean	1.9847350120544434
	GearOilPressure_Min	1.8999999761581421
	GearOilPressure_Min_LastWeek	-0.10000000149011612
	Settings	
	Temperatures	

Visuals

- Central **SharePoint** portal driven by **AF**
- **Graphics** targeted from top level down to individual components
- Developed context aware **Alarm and Event** webpart
- **Health monitoring**
- **Asset Framework** ties together PI data, context for AE data, SharePoint navigation, ACE calculation configuration



Technical Challenges Faced

- Ensuring **security** requirements met when connecting to the station PLCs.
- **Tag naming** conventions
- Deciding on consistent asset **structure**
- **SharePoint** integration
- Coordinating multiple **vendors**



Handover

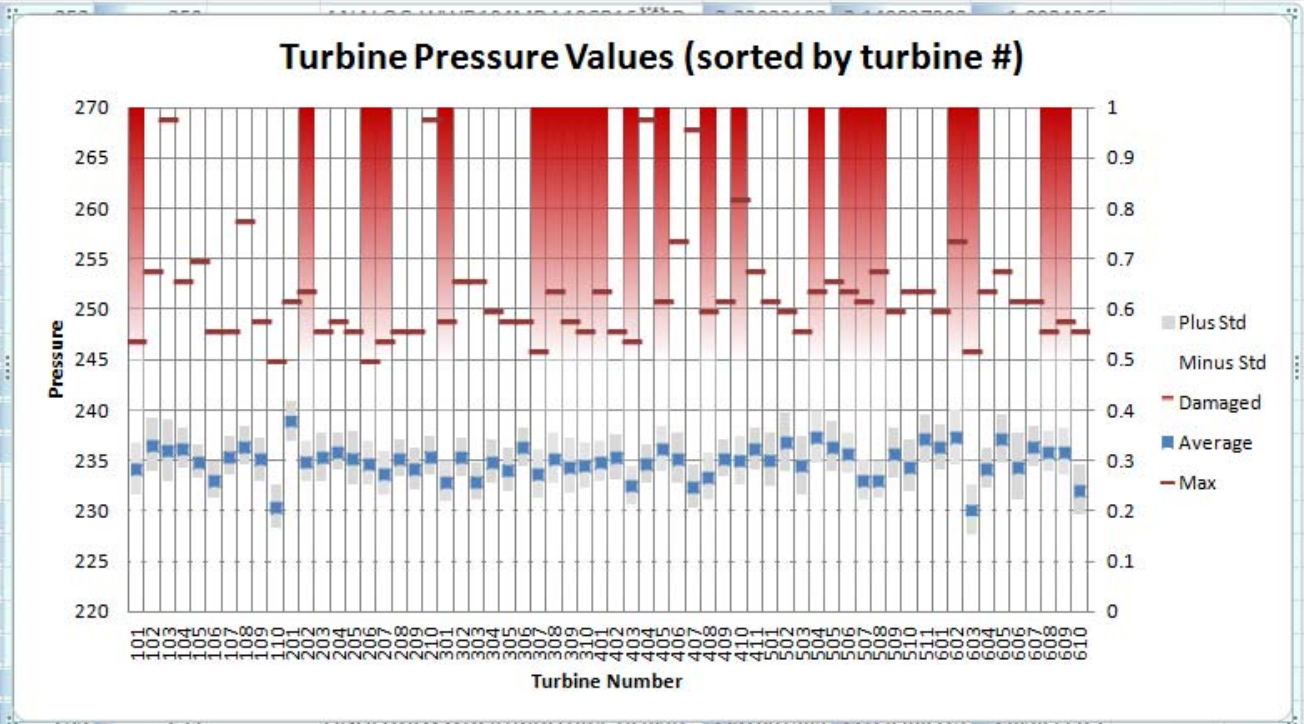


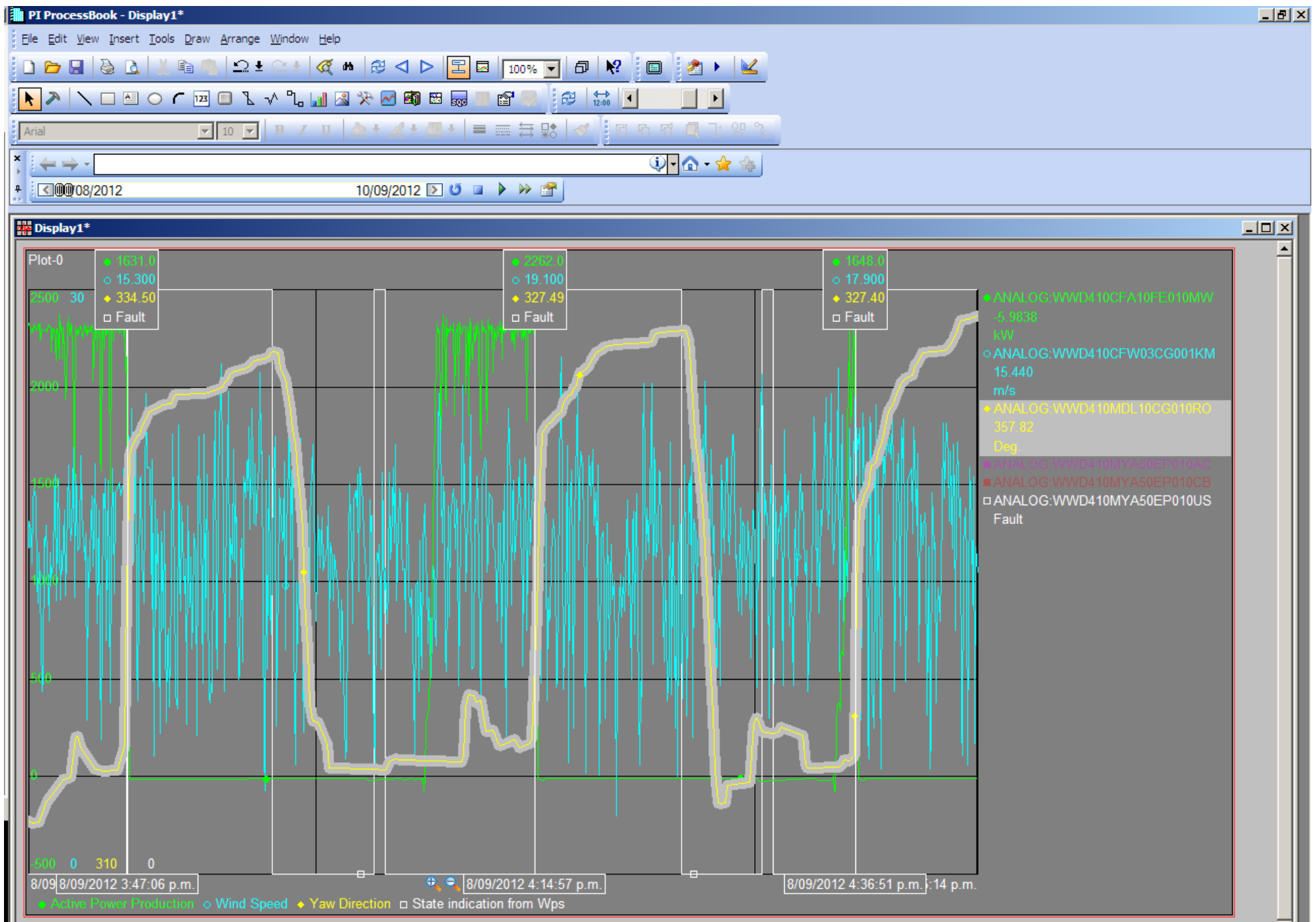


Outcomes

- Engineering Investigations

	A	B	C	D	E	F	G	H	I	J	K	L
1			Maximum					Std Deviation				
2			1/01/2010	1/01/2011	1/01/2012	1/01/2013		1/01/2010	1/01/2011	1/01/2012	1/01/2013	
3		ANALOG:WWD101MDA10CP1640MA	250	266	250		ANALOG:WWD101MDA10CP1642SD	2.41099232	2.144680311	2.152640315		A
4		ANALOG:WWD101MDA10CP1644MA	247	264	245		ANALOG:WWD101MDA10CP1646SD	2.82844737	2.631015353	2.642463412		A
5		ANALOG:WWD101MDA10CP1648MA	250	266	247	266	ANALOG:WWD101MDA10CP1650SD	2.79871567	2.554955443	2.599589716	2.5292778	A
6		ANALOG:WWD102MDA10CP1640MA	253	254	255		ANALOG:WWD102MDA10CP1642SD	2.87026919	2.64596948	2.599052301		A
7		ANALOG:WWD102MDA10CP1644MA	253	254	255		ANALOG:WWD102MDA10CP1646SD	2.78067869	2.54455426	2.498072056		A
8		ANALOG:WWD102MDA10CP1648MA	252	253	254	255	ANALOG:WWD102MDA10CP1650SD	2.90020582	2.683574548	2.662047789	2.6871582	A
9		ANALOG:WWD103MDA10CP1640MA	252	251	268		ANALOG:WWD103MDA10CP1642SD	2.27925532	2.376152591	3.060500714		A
10		ANALOG:WWD103MDA10CP1644MA	254	252	270		ANALOG:WWD103MDA10CP1646SD	2.28364991	2.386859499	3.085535906		A
11		ANALOG:WWD103MDA10CP1648MA	253	251	269	270	ANALOG:WWD103MDA10CP1650SD	2.25895022	2.349715012	3.043315116	2.569326	A
12		ANALOG:WWD104MDA10CP1640MA	253	252	253		ANALOG:WWD104MDA10CP1642SD	2.30555259	2.113065273	1.98572106		A
13		ANALOG:WWD104MDA10CP1644MA	254									A
14		ANALOG:WWD104MDA10CP1648MA	255									A
15		ANALOG:WWD105MDA10CP1640MA	252									A
16		ANALOG:WWD105MDA10CP1644MA	252									A
17		ANALOG:WWD105MDA10CP1648MA	252									A
18		ANALOG:WWD106MDA10CP1640MA	252									A
19		ANALOG:WWD106MDA10CP1644MA	253									A
20		ANALOG:WWD106MDA10CP1648MA	252									A
21		ANALOG:WWD107MDA10CP1640MA	257									A
22		ANALOG:WWD107MDA10CP1644MA	258									A
23		ANALOG:WWD107MDA10CP1648MA	257									A
24		ANALOG:WWD108MDA10CP1640MA	253									A
25		ANALOG:WWD108MDA10CP1644MA	253									A
26		ANALOG:WWD108MDA10CP1648MA	253									A
27		ANALOG:WWD109MDA10CP1640MA	264									A
28		ANALOG:WWD109MDA10CP1644MA	267									A
29		ANALOG:WWD109MDA10CP1648MA	267									A
30		ANALOG:WWD110MDA10CP1640MA	251									A
31		ANALOG:WWD110MDA10CP1644MA	251									A
32		ANALOG:WWD110MDA10CP1648MA	251									A
33		ANALOG:WWD201MDA10CP1640MA	253									A
34		ANALOG:WWD201MDA10CP1644MA	252									A
35		ANALOG:WWD201MDA10CP1648MA	254	259	251	259	ANALOG:WWD201MDA10CP1650SD	2.24102104	1.947820088	1.986283952	2.1246444	A

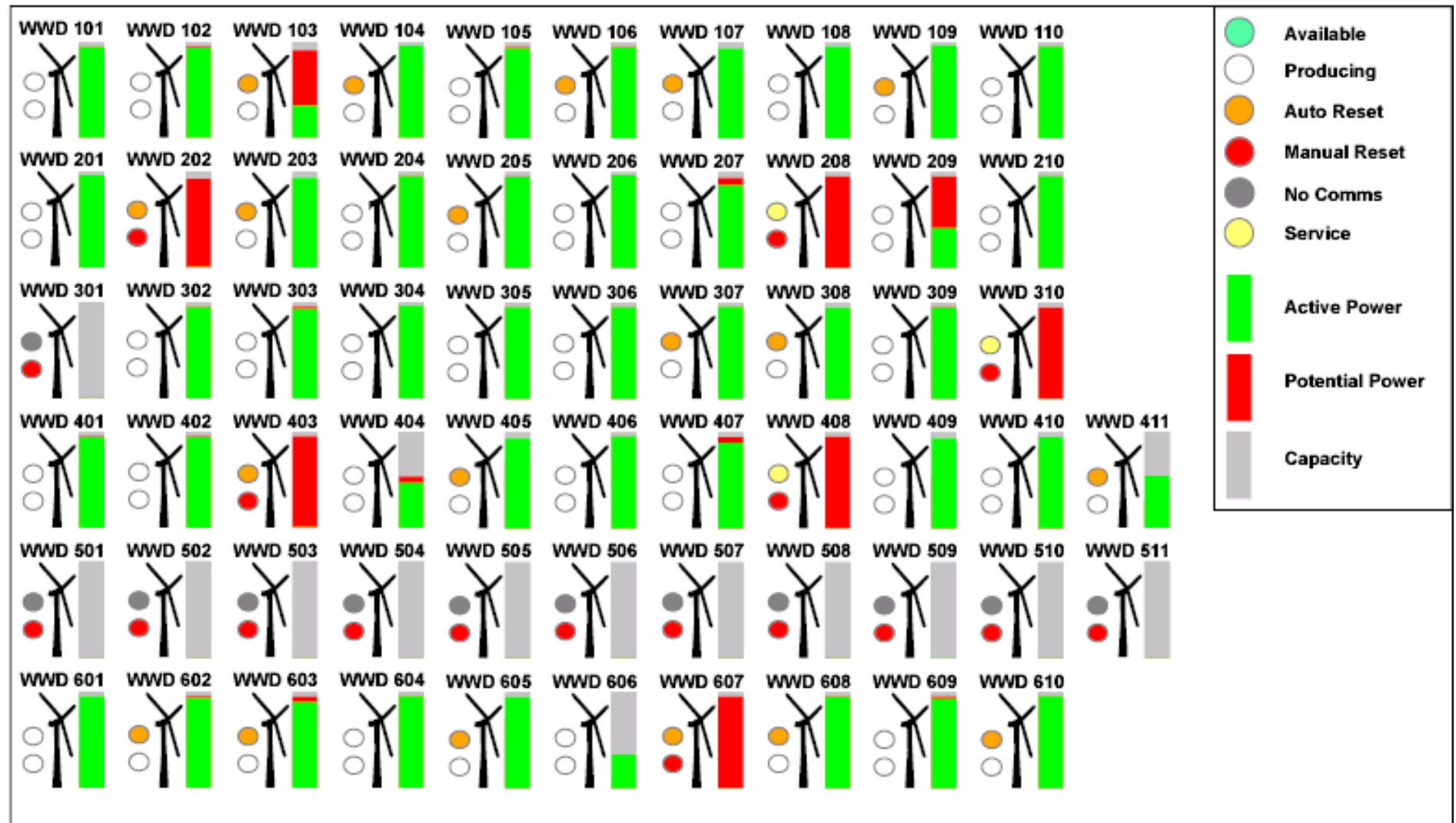
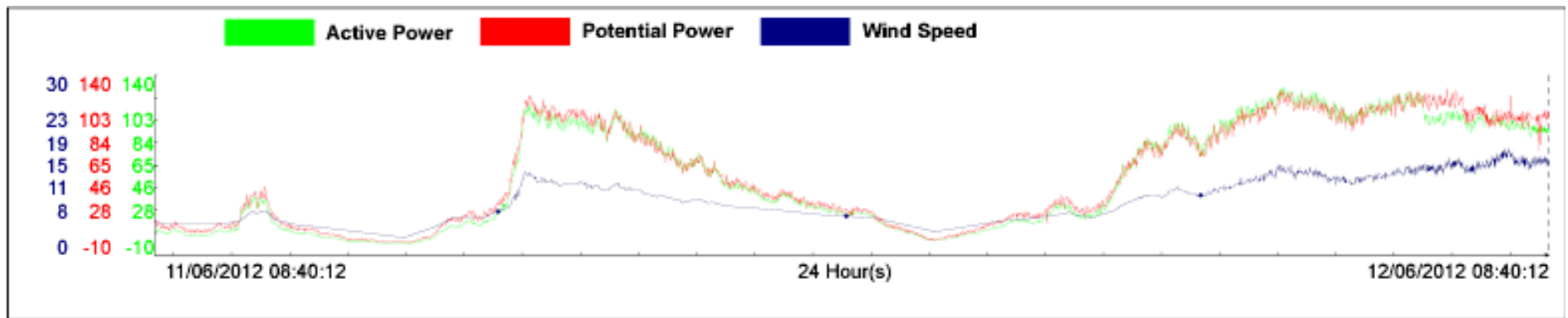






Outcomes

- Engineering Investigations
- Overview of Wind



	Turbines	Available	Running	Auto Reset	Manual Reset	Service Mode	No Comms
TUK	28	27	27	3	0	1	0
TAP	55	---	---	---	---	---	---
WWD	62	56	56	22	1	4	1
WHL	29	---	---	---	---	---	---

POWER PRODUCTION

TE UKU 28.9 MW

REACTIVE POWER: -2.2 MVar

WIND SPEED: 14.5 m/s

TE APITI 1.5 MW

REACTIVE POWER: ---

WIND SPEED: 6.7 m/s

WEST WIND 111.2 MW

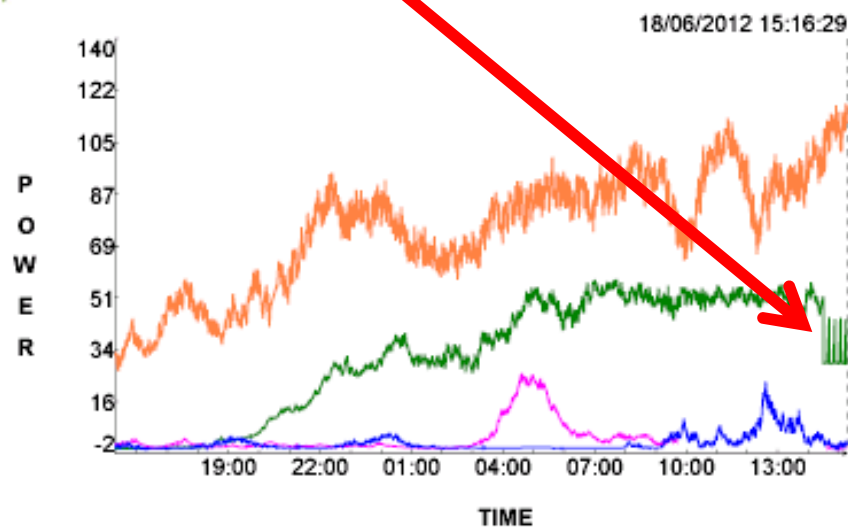
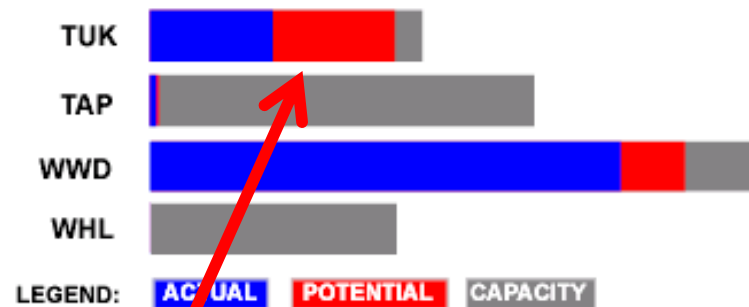
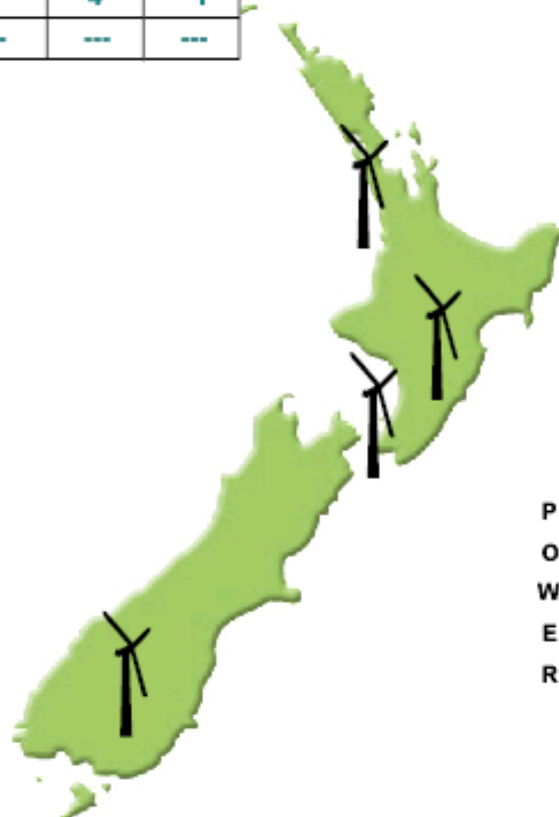
REACTIVE POWER: 37.4 MVar

WIND SPEED: 13.4 m/s

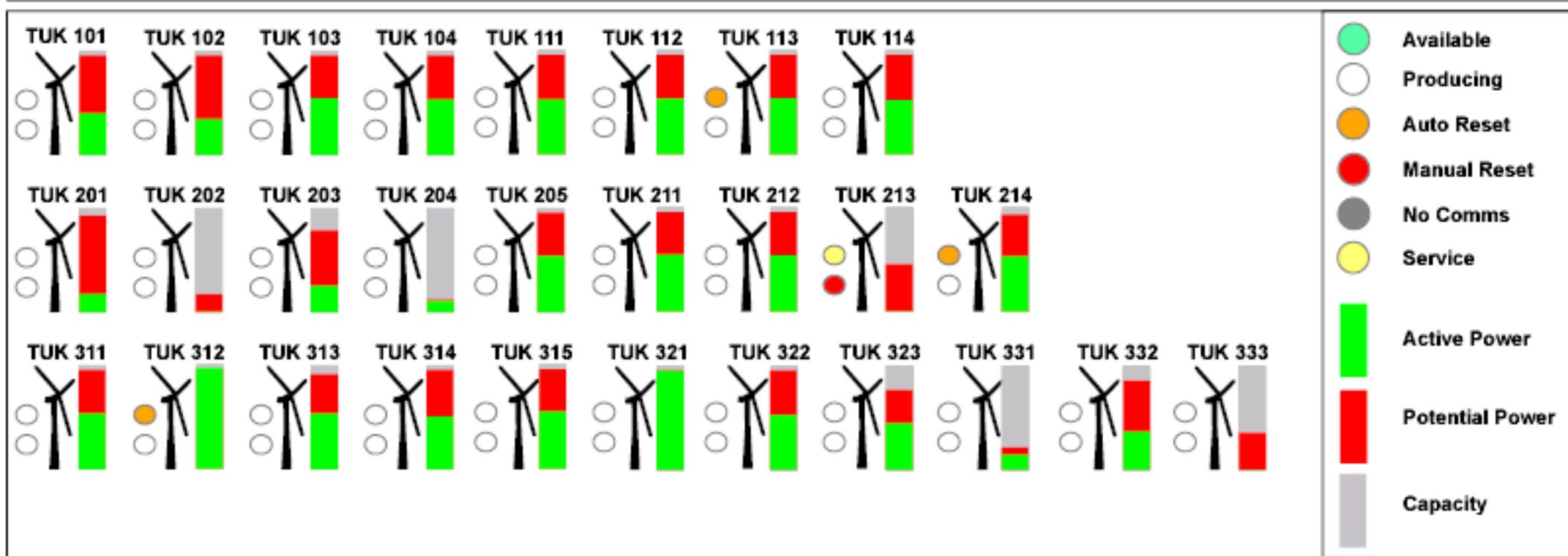
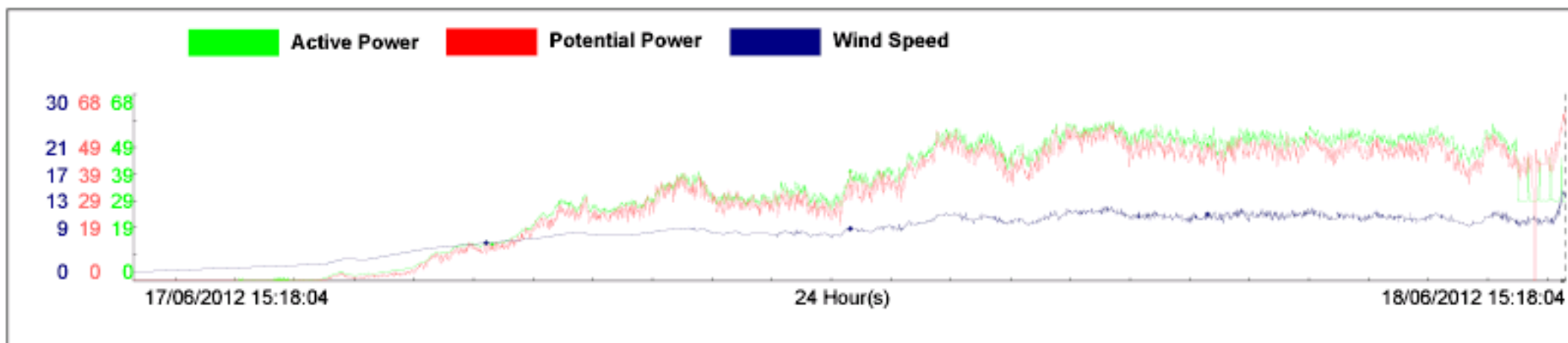
WHITE HILL -0.1 MW

REACTIVE POWER: ---

WIND SPEED: 2.1 m/s



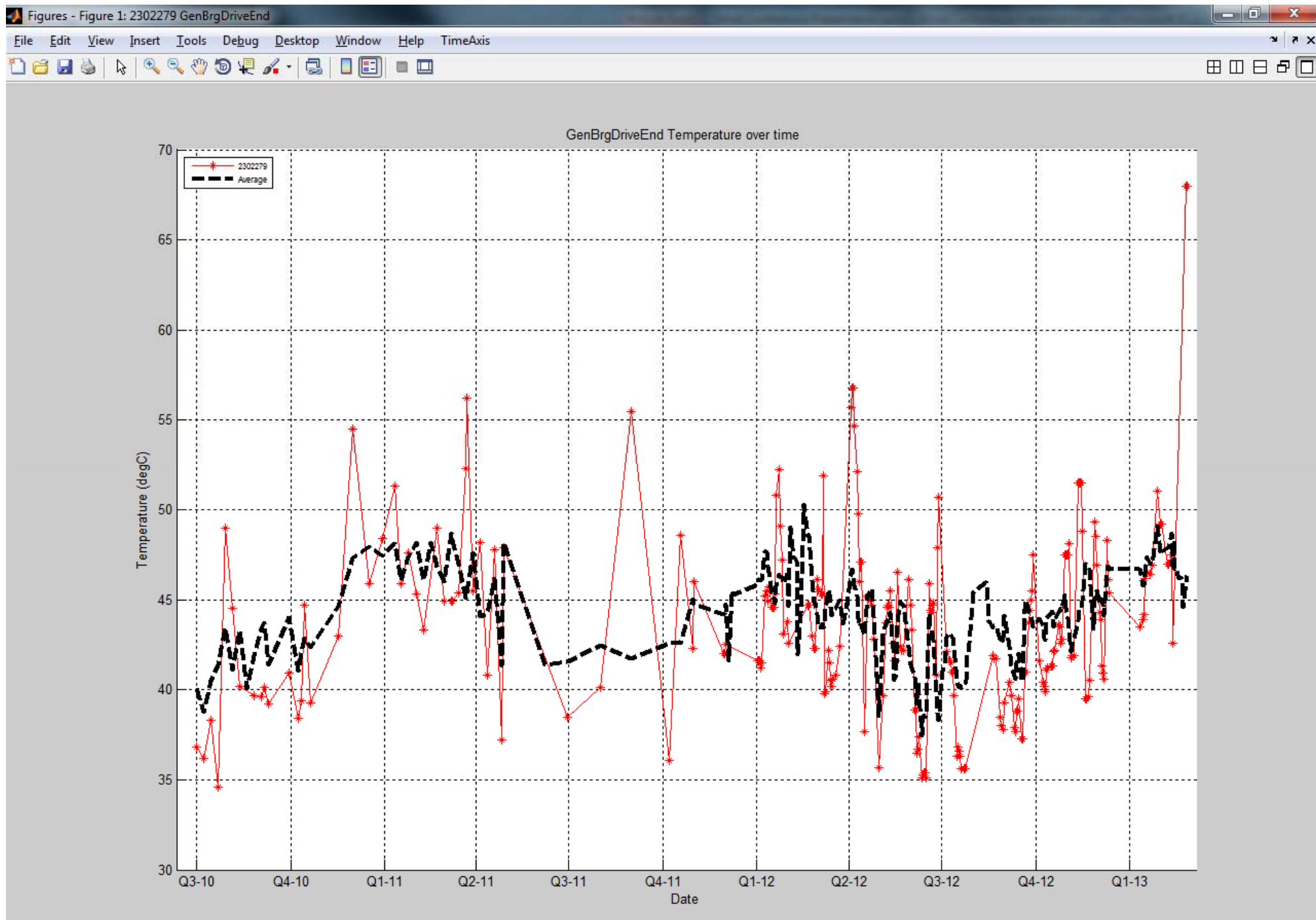
LEGEND: WWD TUK WHL TAP

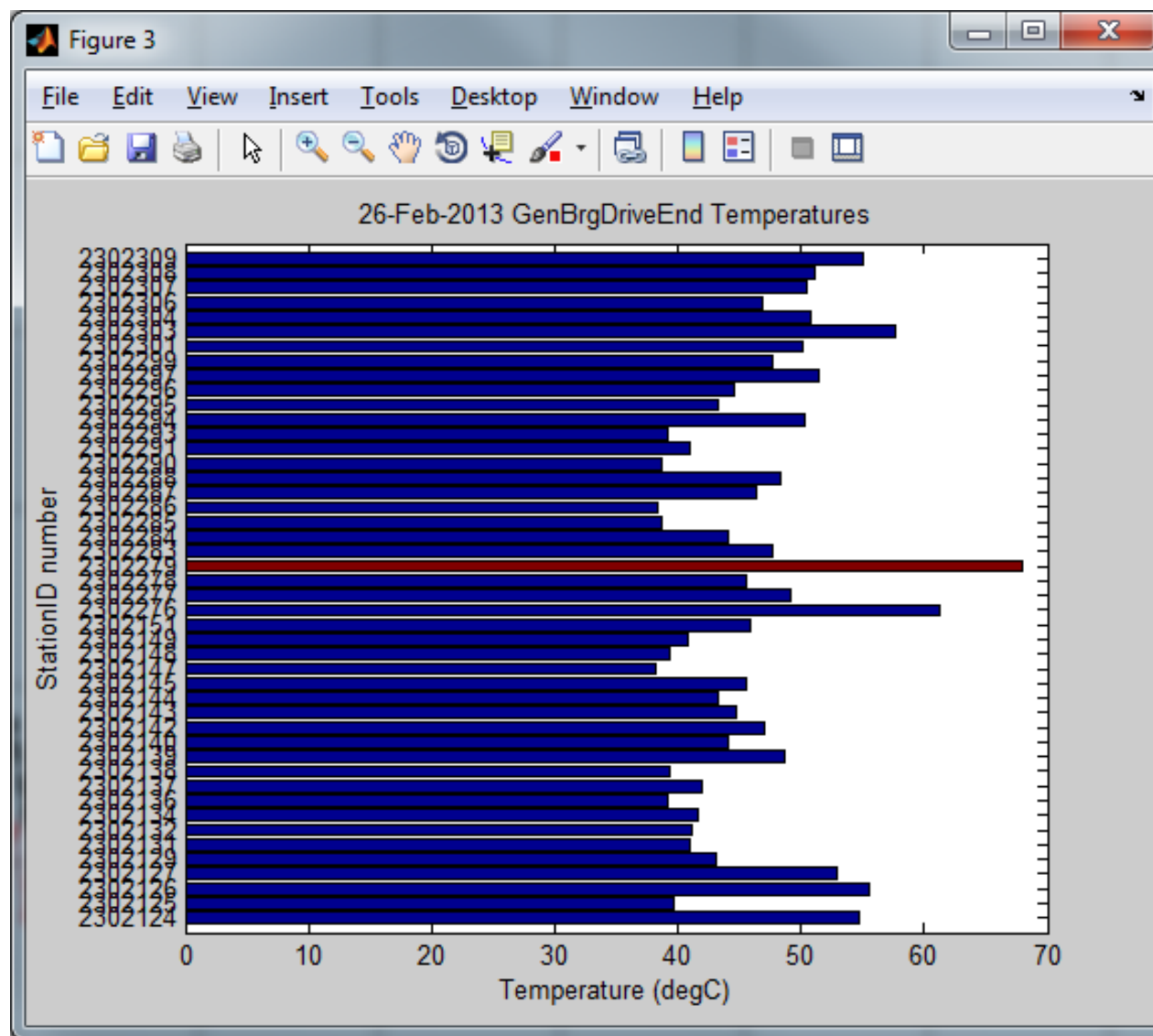




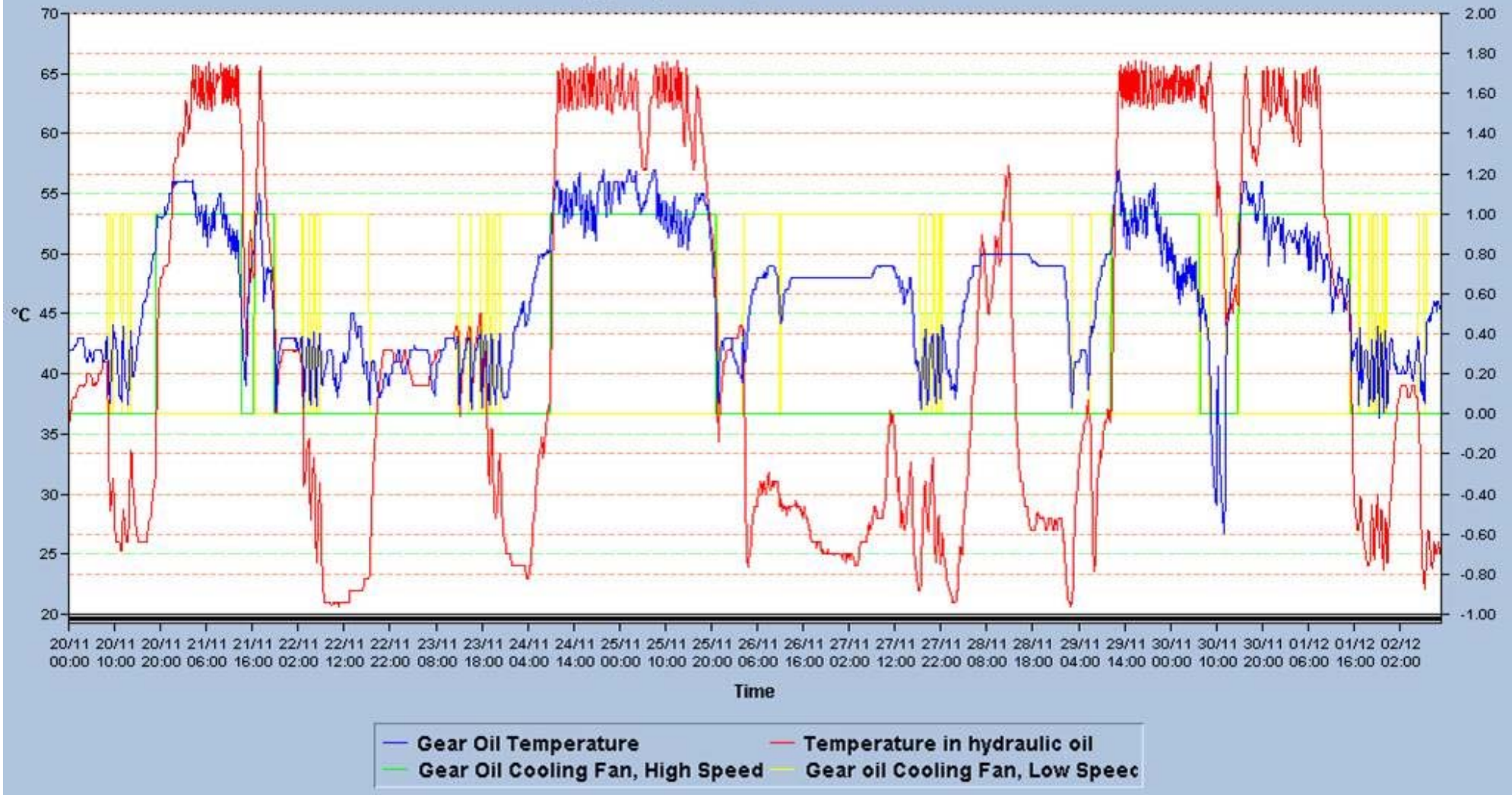
Outcomes

- Engineering Investigations
- Overview of Wind
- Root Cause Analysis





History, Graph View, West Wind - WWD511





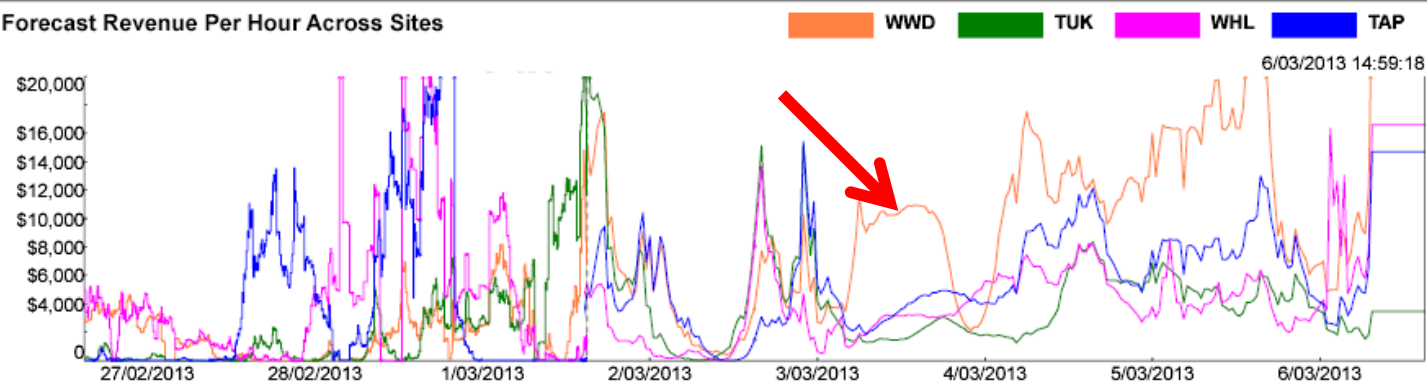
Outcomes

- Engineering Investigations
- Overview of Wind
- Root Cause Analysis
- Operations and Maintenance Planning

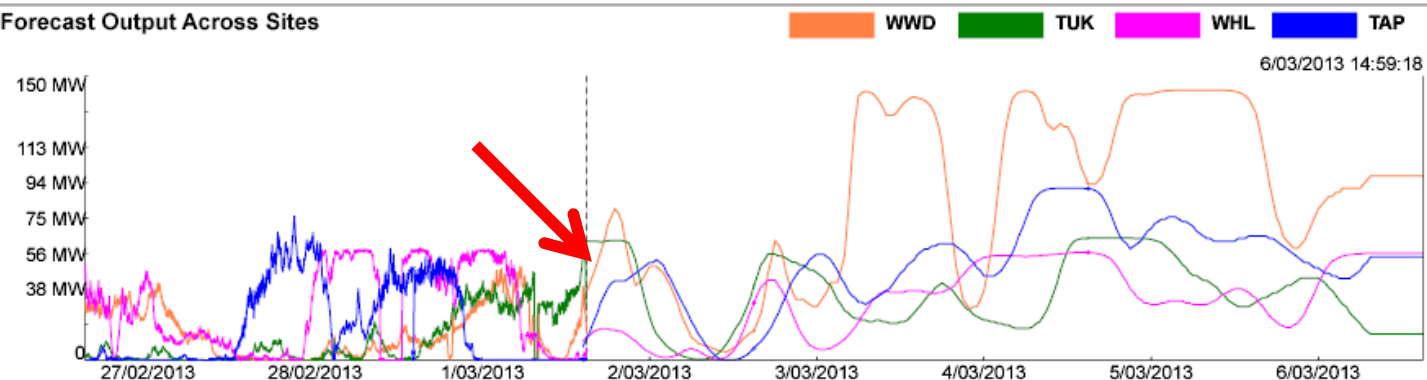
- WindFarms
 - Alarm Log
 - Monitoring
 - Potential Revenue
 - TAP
 - TUK
 - WHL
 - WWD

	WWD	TUK	TAP	WHL
Current \$/MWh:	\$422.74	\$400.60	\$417.41	\$443.69
Current Output:	16.1 MW	29.2 MW	0.4 MW	4.1 MW
Current Revenue Per Hour:	\$6,810.72	\$11,686.14	\$174.85	\$1,815.98
Current Wind Speed:	5.60 m/s	11.50 m/s	2.90 m/s	2.10 m/s

Forecast Revenue Per Hour Across Sites



Forecast Output Across Sites





Project Challenges Faced

- Justifying that more information will make money
- Interaction between teams to get things done
- Spread of the project team
- What don't we know?



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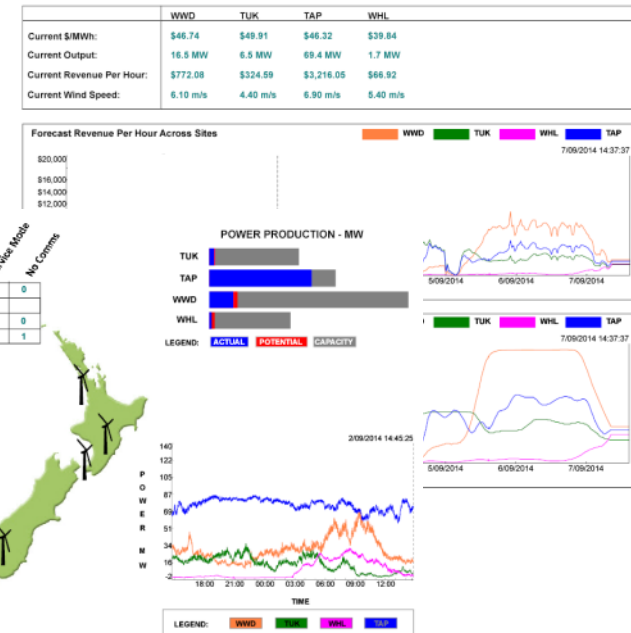
Next Steps

- Reporting
 - KPIs
 - Standard Reports
 - Site Managers
 - Reliability Reports
- Additional Analysis Methods
 - All sites in Matlab
- Benchmarking

PI system for Wind - Wind Conference 2013

"...A very sexy solution. I think this is better than X-box"

Australian Wind Farm owner and operator.



Business Challenge

- Obtaining the necessary information to own and operate our own wind farms

Solution

Purpose built PI for Wind system by Dimension Software

Results and Benefits

- Detailed Engineering Investigations and Outcomes now possible
- Multi functional displays viewed across the business

Henrico van Niekerk

- Henrico.vanniekerk@meridianenergy.co.nz
- Reliability Engineer
- Meridian Energy Ltd



David Barker

- David@dimensionsoftware.co.nz
- Managing Director
- Dimension Software Ltd





THANK YOU

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