The PI System Journey

- Steve Cooper – PI Support Engineer
- Dave Wilson – PI Support Engineer

Agenda

- E.ON UK
- E.ON Gas Fleet – Combined Cycle Gas Turbine & Combined Heat and Power
- E.ON UK's PI System Infrastructure
- Performance Systems Optimisation Team
- PI System Projects
  - Load Monitoring
  - Real Time Performance Monitoring
  - Third Party Access To Plant Information
  - Replacement Of Obsolete Equipment
- E.ON's PI System Strategy 2011/2012 and beyond
- Summary Of The Key Benefits - Testimonial

E.ON UK

- **Business - Electricity Generation**

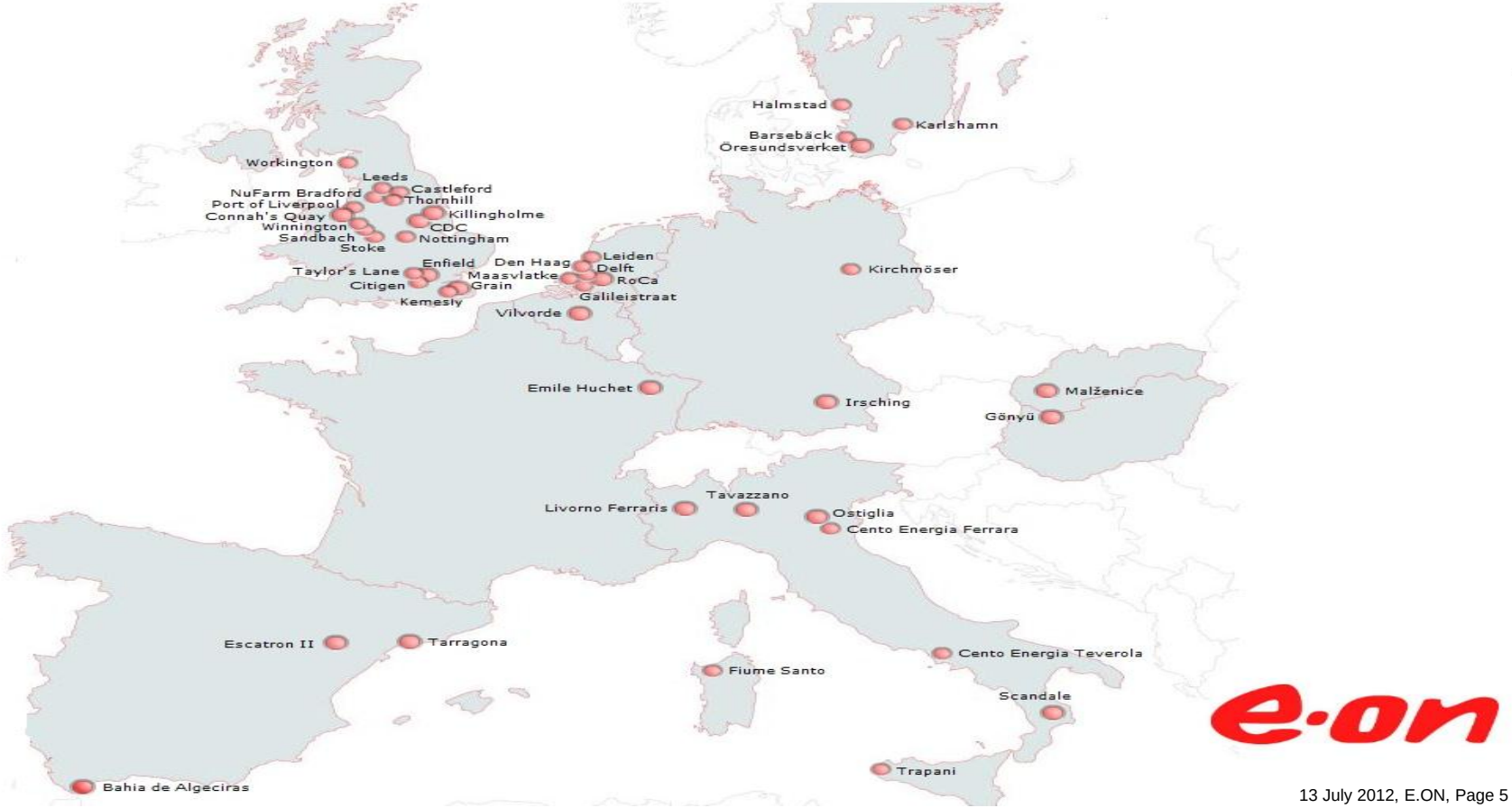
- The UK has 5 GW of coal-fired generation capacity, across three sites and 4.4 GW of Gas across 18 sites.

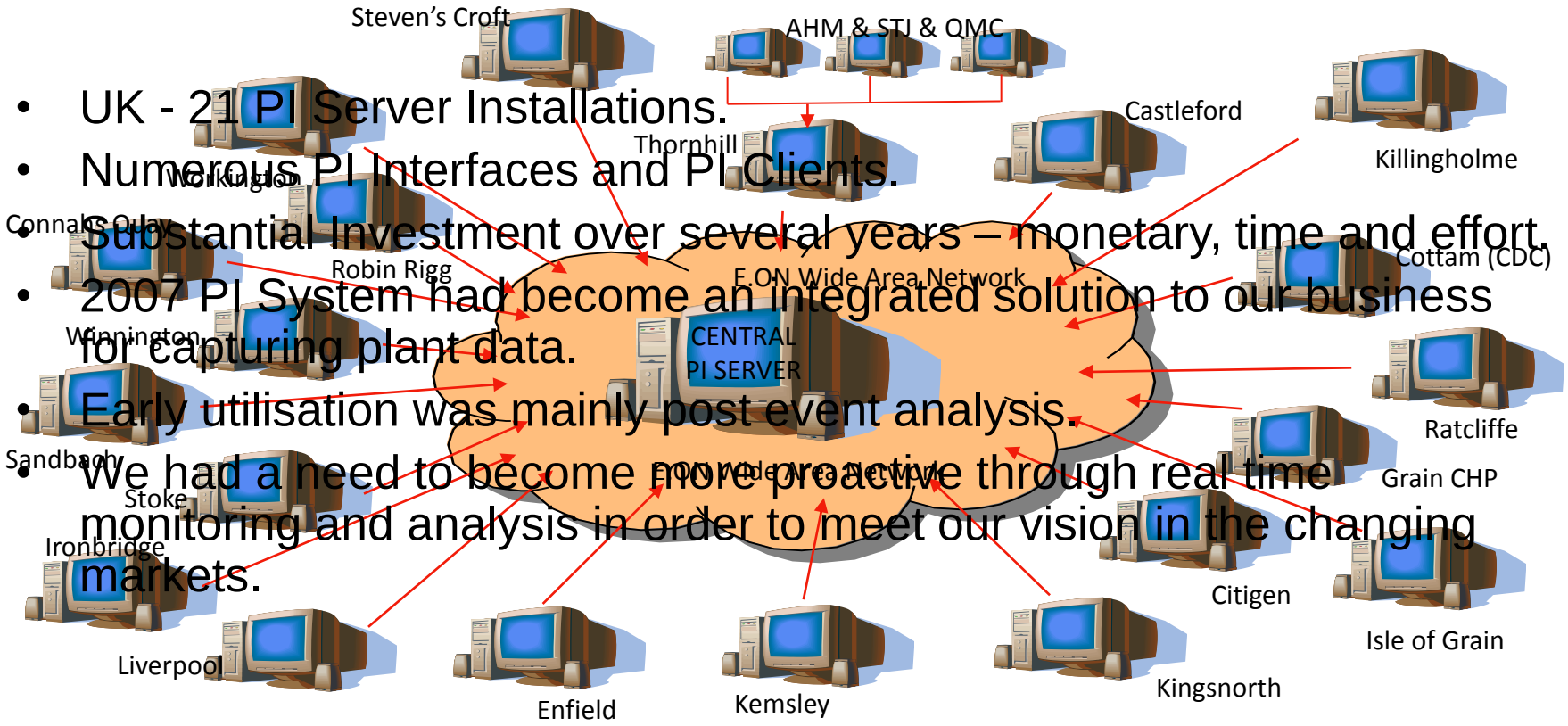
- 2010 business restructure led to the fleet being split into steam and gas which resulted in two Global Fleet Management Centre's (FMC)
    - **Germany – Steam**
    - **UK - Gas**

E.ON (CCGT Fleet)

- E.ON's Gas-CCGT Fleet is present in 10 countries and responsible for a total of 69 units on 40 sites. We have an installed capacity of around 18 GW.
- We have a vision as being recognised as the **best managed portfolio worldwide.**
- Our business is simple and we will achieve our goal through a key focus on the following areas:
  - **Safety and the environment**
  - **Compliance**
  - **Making Money - we make more money by improving**
    - **Plant capacity**
    - **Availability**
    - **Flexibility**
    - **Reliability**
    - **Efficiency**
    - **Reducing costs**

E.ON CCGT & CHP Fleet



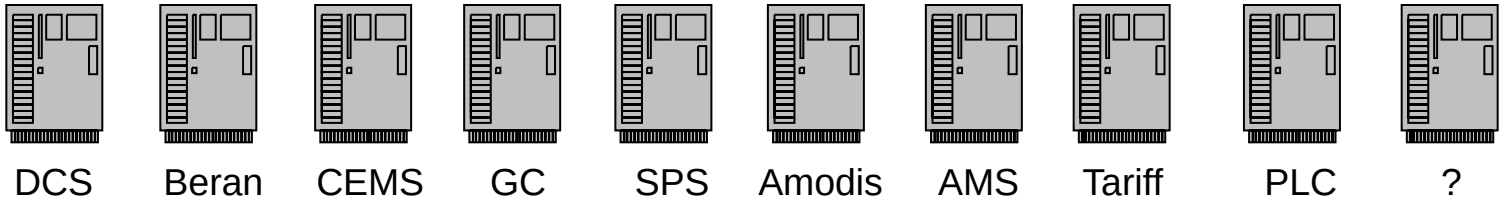


- UK - 21 PI Server Installations.
- Numerous PI Interfaces and PI Clients.
- Substantial Investment over several years – monetary, time and effort.
- 2007 PI System had become an integrated solution to our business for capturing plant data.
- Early utilisation was mainly post event analysis.
- We had a need to become more proactive through real time monitoring and analysis in order to meet our vision in the changing markets.

Performance Systems Optimisation Team

- We are a small Team of 5.
- Established 2007.
- Manage/support and develop a standardised integrated fleet wide plant data acquisition system.
- Ensure the data source providing the information to the business is uninterrupted, reliable and accurate.
- Assist in the development of both value added applications and people, enabling the business to maximise its investment.
- Centre of excellence within the Generation business.

Evolving System



PI ProcessBook

PI DataLink

GPMS

SAP

PI WebParts

Opralog

ENT - Apps

Key Fleet & Site Specific Projects

- **Interface Failover** – Ensures a more secure data capture environment.
- **LMW Project** – Load Monitor Watchdog (Imbalance tracking).
- **Web Pages Employed** – Displays plant generation overview and allows third party access to authorised data.
- **Future data importing** – through the UFL interface it is possible to compare real values to future forecasts.
- **Capturing of web based data** – Utilising the HTML interface to record data into the PI System from the web i.e. Electricity buy/sell prices etc.
- **SAP integration** – Pushes run time data to SAP for a more accurate maintenance schedule.
- **Weather data** – import and export to Meteor & Metra Groups (**TriGas & CQ).**
- **Performance Watchdog development.**

Imbalance Monitoring

- **Background**
  - UK fleet annual imbalance costs have been in the range of £9M-£12M per annum for 2007,8,9.
  - Main contributing events, trips and failed starts.
  - Other contributing events, missed load change instructions and plant issues causing imbalance which could be corrected.
  - Monitoring and correction of the latter events could yield an estimated loss reduction of approximately £0.5M/year saving for the UK fleet.
- **Requirement**
  - Develop a load monitoring watchdog.
  - Display real time and future data on the same screen.
  - Highlight potential plant problems.

Imbalance Monitoring

- **Solution**
  - Bring future data into the PI System, one data source eliminates the need for ODBC connections etc. Utilising the PI UFL Interface write future data into history.
  - Develop the necessary Performance Equations.
  - Manual input would be required to adjust constants used in calculations.
  - Develop the necessary screen displays ensuring that they are standardised for deployment across the fleet.

- **PI System Products Employed**
  - PI Server – data, PE's.
  - PI UFL Interface – future data into the PI System.
  - PI ProcessBook – displays and data sets.
  - PI HTML Interface – pricing data from the internet.

- **Benefits**
  - Provides the right information to the Operator to allow him to control the imbalance.

Main LMW Screens

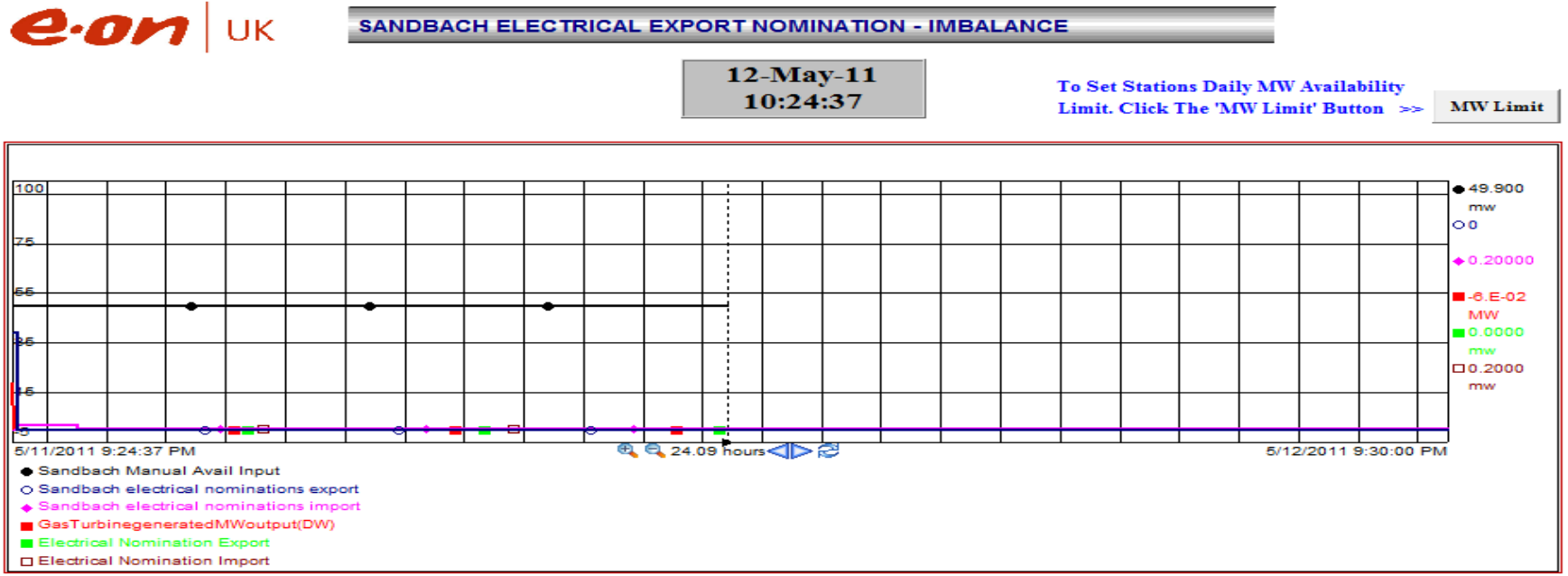
Load Management Watchdog Manual Entry - CQU3

	New Value (typed in box)	Button sends value to PI	Latest Value
LMW_CQ_U3_Alert tolerance on closeness of load set-point to PN	3	Update Value	2/2/2010 10:55:58 AM 2
Tag Name LMW_CQ_U3_Alert tolerance on imbalance	2	Update Value	2/2/2010 10:56:10 AM 3
Tag Name LMW_CQ_U3_Alert tolerance on imbalance volume	1	Update Value	12/10/2009 2:20:22 PM 1
Tag Name LMW_CQ_U3_Alert tolerance on imbalance cost	100	Update Value	12/10/2009 2:20:23 PM 100
Tag Name LMW_CQ_U3_Unit capacity	390	Update Value	1/26/2010 12:52:36 PM 345
Tag Name LMW_CQ_U3_Permitted % load deviation from PN	0.75	Update Value	12/10/2009 2:20:25 PM 0.75

Return To Main Screen

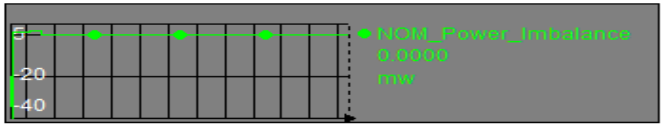
You Must Be Logged Into PI With The LMWAdmin Account To Write Values To PI

Real Time & Future Data Display



This Screen Displays:

- Current Real Time Export Values (mw)
- Sandbach Nomination/Renomination Forecast Data (mw)
- Current Daily Availability (mw)
- Sandbach Import Nomination/Renomination Forecast Data (mw)



Real Time Plant Monitoring

- **Background**
  - GT Air Inlet Bleed Heating Valve found open at around 8%, bleeding off warm air to the GT Air Inlet. PI Trends indicated that this had been the case for almost 3 Days.
  - After closing valve, Cycle Output increased by 7MW & Efficiency increased by 0.5%.
  - This incident alone was estimated to have cost over £20k in lost generation.
- **Requirement**
  - Develop a real time monitoring system that gives easy visualisation of plant conditions highlighting issue so that they can be addressed quickly.
- **Solution**
  - Develop the necessary Performance Equations.
  - Develop the necessary site screen displays.

Real Time Plant Monitoring

- **PI Products Employed**
  - PI Server – Plant data, PE's.
  - PI ProcessBook – Control room displays.
  - PI HTML Interface – Prices.
- **Benefit**
  - Early indication of issues effecting performance and efficiency.
  - Reduction in response time therefore reduction in losses.
- **Example** – Control Room PI ProcessBook Displays at Connah's Quay helps maintain a 0.5% efficiency improvement per unit, through optimising output and performance, saving of over £4m per year across the site.

CQ – Performance Watchdog

Gas Cap Delivery | More Detail

Overview of Performance Indicators

BHP Trend

BHP Target Revenue £23,425 /hr

Gain / Loss against Target £112 /hr

Current BHP Gas Cap Delivery 100.4 %

GTP PI Link Status

	U1	U2	U3	U4
Calculated Base Load	311	310	311	320 MW
Actual Exported Load	311	308	308	321 MW
Works Power	6.2	6.6	6.2	6.3 MW
Exported Efficiency	50.98	51.37	50.84	52.20 %

1249 MW

Base Load

PI / GPMS Link Status

Duty Shift
CQ_D_Shift

		(Run up Rate) Unit 1	Unit 2	Unit 3	Unit 4	Performance Indicator
More Detail	Imbalance Excel					Negative Imbalance > 2MW
More Detail	Check Unit MEL					Calculated Base Load above PN by > 3MW
More Detail	MEL < CC Load SP					DCS MEL less than CC Load Setpoint
More Detail	Check Freq Resp					Requested position and actual differ
More Detail	CT Fans			8	8	Less than 10 Fans in Service
More Detail	CTA Skids					CTA system operational
More Detail	CT Louvres					Are We Pluming?
More Detail	CT Bypasses					Valves Open
More Detail	ACO Drains					High ACO Drains Temp
More Detail	Steam Bypasses					Bypass Open > 5%
	Bleed Heating					Bleed Heating Open > 3%

CW System

Yes No

(Please Select)

Third Party Access – Utilisation Of PI WebParts

- **Background**
  - Steven's Croft Biomass plant had a fuel shortage over a Christmas holiday period, which meant the plant had to reduce load until fuel, in the form of wood chips, could be imported.

- **Requirement**
  - Provide the fuel supplier with a view of the fuel storage silo's.
  - Provide this view even though they are outside of the E-ON I.T. influence.
  - Display real time data on fuel levels, belt weigh data, and site loading.

- **Solution**
  - Develop a web based screen display that can be accessed by the fuel supplier from his regional office and at the local plant.
  - Provide security controls for access and data control.

Third Party Access – Utilisation Of PI WebParts

- **PI Products Employed**
  - PI WebParts.
  - PI Server and Web Server – data and PE's.

- **Benefit**
  - Security of supply for both fuel and plant output.
  - Efficient fuel management.

Steven's Croft Web Page

Steven's Croft > Jenkinsons Site

Jenkinsons Site

This Site

Summary | Fuel Supply | Reclaimers

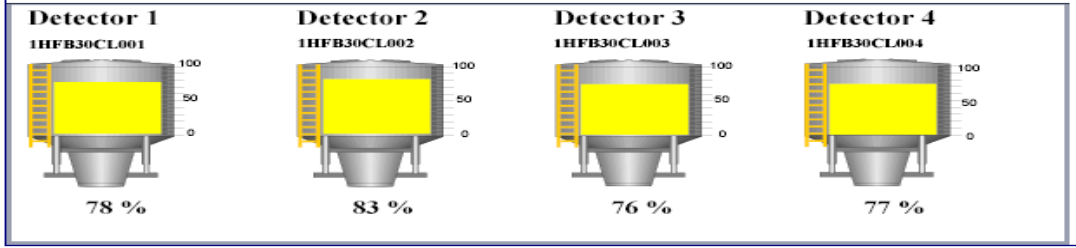
JENKINSON'S SUMMARY PAGE

GENERATOR (MW) & CONVEYOR DATA

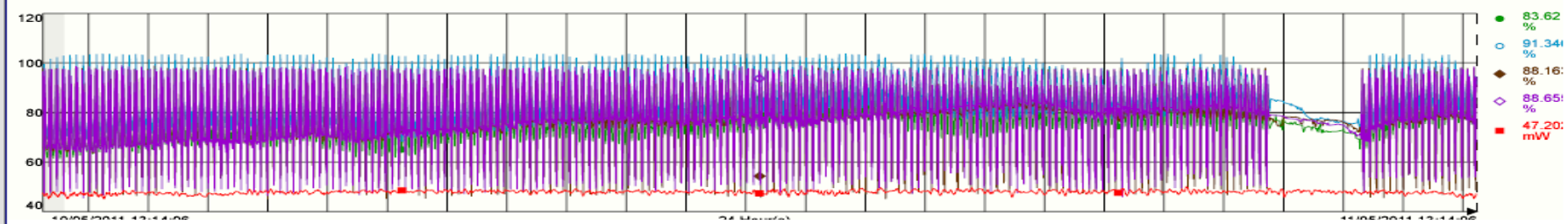
Stevens Croft MW Generator Output
47.901 mW
11/05/2011 13:15:04

Fuel To A-Frame Conveyor (HFB10)	ON
Fuel To A-Frame Conveyor (HFB20)	ON
A-Frame Shuttle Conveyor FWD (HFB30)	Off EAST
A-Frame Shuttle Conveyor REV (HFB30)	ON WEST

A FRAME SILO STORAGE LEVEL



GENERATOR LOAD (MW) & A-FRAME SILO LEVELS



BELT WEIGHER DATA

Descriptor	Time	Value
Belt Weigher 1 (1HFB40CW001 tonnes per half hour)	11/05/2011 12:00:00	10.00
Belt Weigher 2 (1HFB50CW001 tonnes per half hour)	11/05/2011 12:00:00	11.00
Belt Weigher 3 (1HFB20CW001 tonnes per half hour)	11/05/2011 12:00:00	0.34
SC Belt1 (1HFB40CW001) 24hr total	10/05/2011 23:59:59	597.00
SC Belt2 (1HFB50CW001) 24hr total	10/05/2011 23:59:59	596.00
SC Belt3 (1HFB20CW001) 24hr total	10/05/2011 23:59:59	9.47

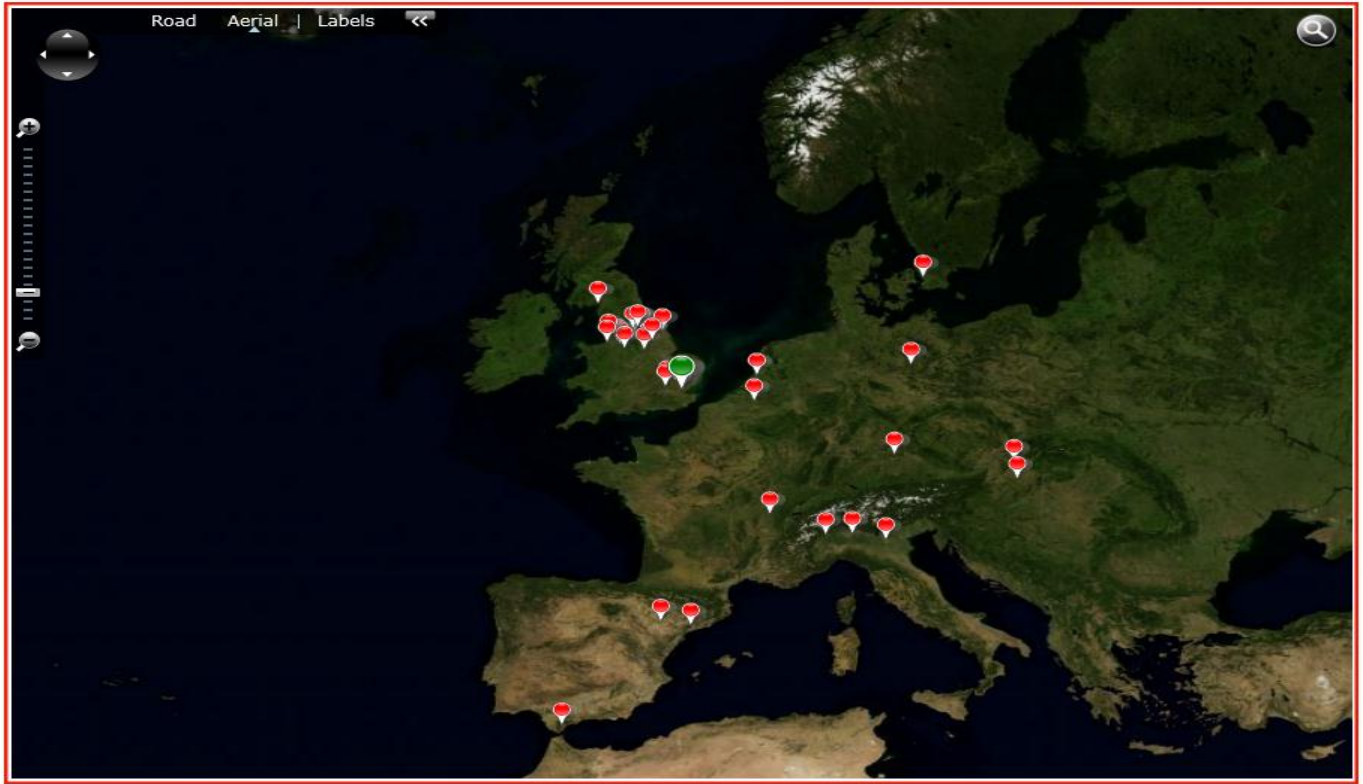
BELT WEIGHER 24hr

GLOBAL CCGT OVERVIEW

26/04/2012 08:44:53

Grain CHP

Total Portfolio Generation 1641.77 MW



UK

Total Load 1641.77 MW

Grain CHP

Total Load	1258.31 MW
Unit 6 Load	406.38 MW
Unit 7 Load	421.38 MW
Unit 8 Load	430.19 MW
Ambient Temp	10.40 C

Thu Apr 26, 2012 08:48:17

Ostiglia | Livorno | Tavazzano | Vilvoorde | Emile Huchet | Connah's Quay | GrainCCGT | Enfield | Killingholme | Cottam | Thornhill | Castleford |

CCGT Overview Page

Links

- Back To Global CCGT Page
- Back To CCGT Overview
- Back To CHP Overview
- Portal CCGT Home Page
- Portal CHP Home Page
- Portal Technical Baseline

TOTAL PORTFOLIO GENERATION (MW)	TOTAL CCGT UNIT GENERATION (MW)
1647.77	1500.63

Click To Scroll

Ostiglia

Descriptor	(MW)
Unit1 Generated Load	0.00
Unit2 Generated Load	0.00
Unit3 Generated Load	0.00

Tavazzano

Descriptor	(MW)
Unit1 Generated Load	0.00
Unit2 Generated Load	0.00
Unit3 Generated Load	0.00

Livorno

Descriptor	(MW)
TDY GT11 ACTIVE POWER V	0.00
TDY GT12 ACTIVE POWER V	0.00
TDY ST Gross Power V	0.00

Emile Huchet

Descriptor	(MW)
Puissance Active (P)	0.00

CDC

Descriptor	(MW)
Unit Generated Load	0.00

Enfield

Descriptor	(MW)
Generated Load	0.00

Thornhill

Descriptor	(MW)
Plant I/O Active Power	0.00

Castleford

Descriptor	(MW)
GTG Active Load	0.00

Connah's Quay

Descriptor	(MW)
U1 - GENERATOR POWER	0.00
U2 - GENERATOR POWER	0.00
U3 - GENERATOR POWER	0.00
U4 - GENERATOR POWER	0.00

Killingholme

Descriptor	(MW)
Net load Gen GT11	122.38
Net load Gen GT12	122.55
Net load Gen GT21	0.00
Net load Gen GT22	0.00

GrainCCGT

Descriptor	(MW)
Unit6 Generated Load	406.00
Unit7 Generated Load	420.16
Unit8 Generated Load	430.56

Vilvoorde

Descriptor	(MW)
Unit1 Generated Load	0.00
ST Net MW	0.00

GrainCCGT Main Overview

Links

- Back To Global CCGT Page
- Back To CCGT Overview
- Back To CHP Overview
- Portal CCGT Home Page
- Portal CHP Home Page
- Portal Technical Baseline

TOTAL SITE GENERATION (MW)
1258.41

Descriptor	(MW)
Unit6 Generated Load	405.16
Unit7 Generated Load	420.16
Unit8 Generated Load	430.19

Station Data

Unit6

Descriptor	(MW/Mvar)
U6 UNIT ACT POWER EXPORT	401.58
U6 UNIT AUX TRANSFORMER MW TO NG	4.57

Descriptor	Value
U6 T AIR INTAKE MANF	10.65
NOX STACK61	44.60
CO STACK61	0.00
O2 STACK61	12.93
GRS FC A STATION ENERGY FLOW RATE	8661.41
FUGAS SOV PTR	51.75
FUGAS SOV TTR	7.92
U6 AMBIENT HUMIDITY	68.49
U6 AMBIENT PRESSURE	993.44
U6 AMBIENT TEMPERATURE	10.72

Unit7

Descriptor	(MW/Mvar)
U7 UNIT ACT POWER EXPORT	416.47
U7 UNIT AUX TRANSFORMER MW TO NG	4.72

Descriptor	Value
U7 T AIR INTAKE MANF	10.63
NOX STACK71	45.40
CO STACK71	1.40
O2 STACK71	12.71
GRS FC A STATION ENERGY FLOW RATE	8661.41
FUGAS SOV PTR	51.75
FUGAS SOV TTR	7.92
U7 Ambient Humidity	72.31
U7 Ambient Pressure	994.49
U7 Ambient Temperature	Pt Created

Unit8

Descriptor	(MW/Mvar)
U8 UNIT ACT POWER EXPORT	425.05
U8 UNIT AUX TRANSFORMER MW TO NG	4.52

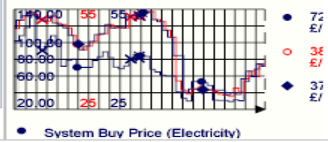
Descriptor	Value
U8 T AIR INTAKE MANF	10.41
NOX STACK81	31.50
CO STACK81	0.00
O2 STACK81	12.79
GRS FC A STATION ENERGY FLOW RATE	8661.41
FUGAS SOV PTR	51.75
FUGAS SOV TTR	7.92
U8 AMBIENT HUMIDITY	71.63
U8 AMBIENT PRESSURE	992.87
U8 AMBIENT TEMPERATURE	10.54

General Data

MARKET DATA

Descriptor	(£/Mwh)
System Buy Price (Electricity)	72.41
System Sell Price (Electricity)	38.65
Market Power price	37.95

MARKET DATA 24HR



Obsolete Equipment Replacement

- **Background**
  - Kings North power station control room was fitted with LCD screens displaying turbine and Boiler temperatures, due to their age they were continually failing. There was a need to either source replacement hardware with newer models or investigate alternative way of displaying the information.

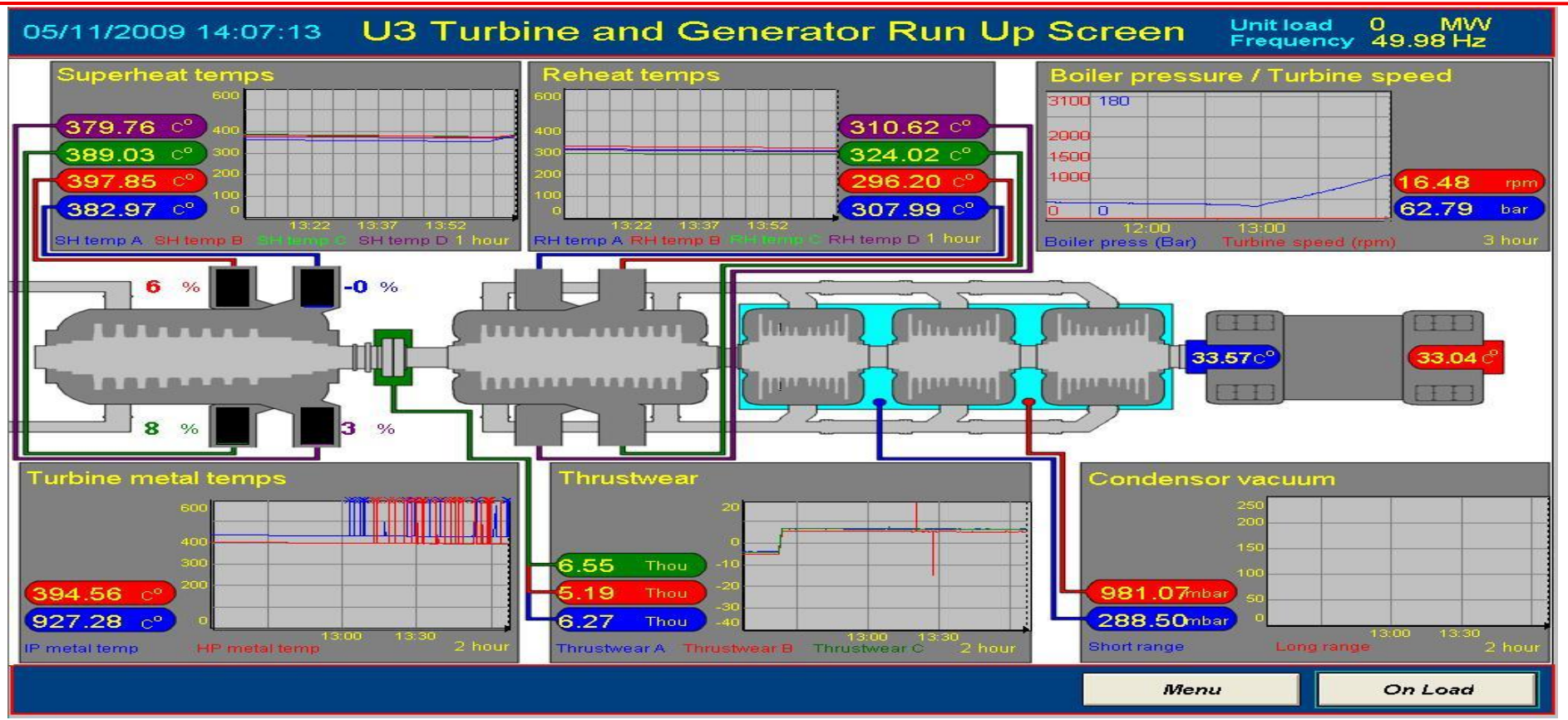
- **Solution**
  - Utilise the PI System to collect and display the data, repair and replacement was too expensive (£112K).
  - Enable the turbine temperature points within separate DataScan units, and allow the PI System to interface via OPC with them.
  - Develop PI ProcessBook displays to show information.
  - Provide large screen displays on control desks.

Obsolete Equipment Replacement

- **PI Products Employed**
  - PI Server – data.
  - PI OPC Interface.
  - PI ProcessBook.

- **Benefit**
  - Large high contrast displays.
  - Overall cost £10K per unit, saving of £72K.
  - Scalability – additional plant information and history.

Obsolete Equipment Replacement

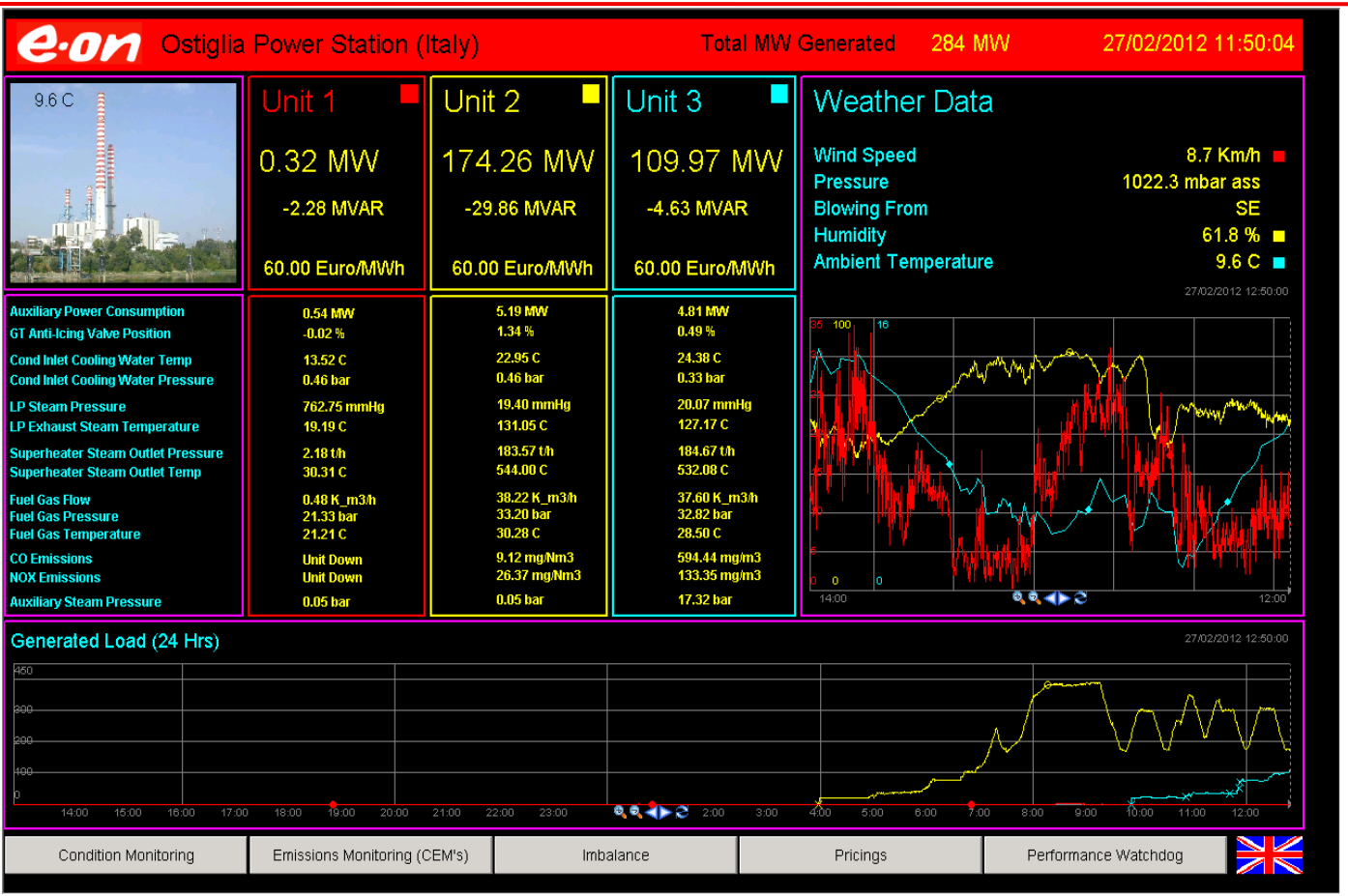


Strategy/Projects for 2012 and beyond

- **Complete Roll out of PI Systems to all of the European CCGT Fleet by Q4 2012**.
- **Establish E.ON CCGT Fleet PI System Infrastructure,** resolve IT issues with central server and cross-boundary communication.
- **Implement new technologies** to allow us to leverage the investment for the business i.e PI Asset Framework , PI Notifications & PI ACE.
- **Showcase Top 5 screens** around all European CCGT sites and build a catalogue of useful screens.
- **Continue development of European CCGT Web Page Displays**.
- **Assist in the deployment of ENT's A**dvanced **C**ondition **M**onitoring
- **Automation of Availability (MEL Shortfall/KPI) Reporting -** Investigating ways to utilise the PI System & Opralog to capture MW export limit re-declaration.
- **Central Italian server** connecting CCGT's and Hydro
- **KPI development** for all UK & European CCGT sites

Strategy/Projects Continued

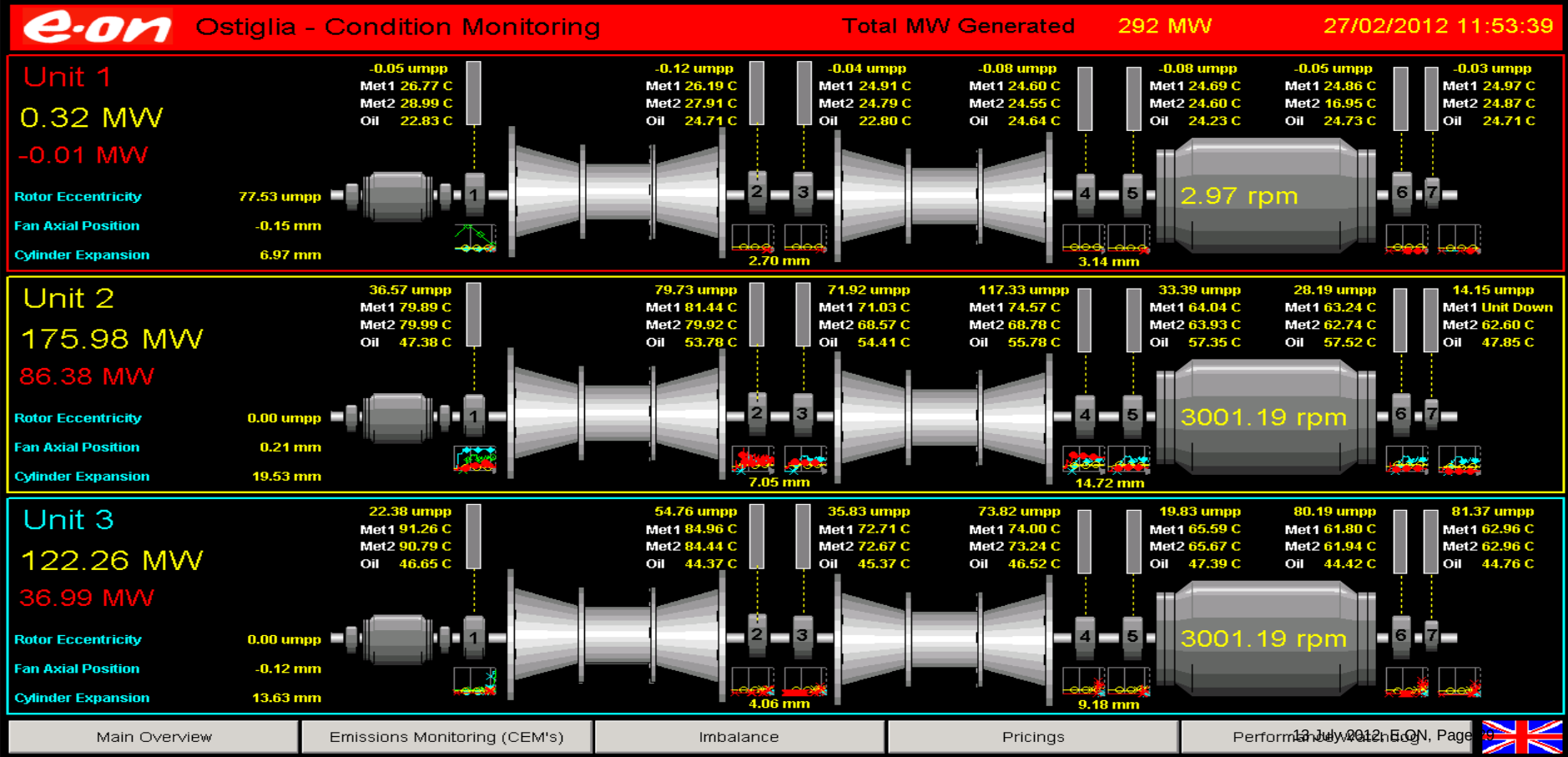
- **CHP Gross Margin/Availability and KPI reporting**.
- **SAP Integration–** develop system to capture plant data according to sites requirements, reducing maintenance costs.
- **Interface Failover –** Employ the failover configuration to minimise any data loss from critical systems i.e. CDAS emissions monitoring.
- **Improve security** and access to the systems to ensure data integrity by employing Windows Integrated Security, removes the need to login.
- **Traffic Light warning system** – configurable alarm points for deviations in plant conditions.



Top 5 Screens

- Site Overview
- Emissions Monitoring
- Condition Monitoring
- Pricing Data/Imbalance
- Watchdog

Condition Monitoring



Summary Of The Key Benefits and Testimonial

- Central repository for Plant Data.
- Interfaces to all forms of data sources.
- Online storage of large quantities of data.
- Data is easily accessed through PI Client Tools.
- Define the views that are relevant to your plant, Customise the data allowing information to be displayed that is not readily available from the DCS.
- Plant data available throughout the whole of the business.

"It allows easy, quick and powerful access to plant information , allowing users in a number of areas to drill down to root cause. It helps us make better, more informed decisions more quickly. It also supports longer term projects that require a good degree of data collection and analysis. It has also enabled us to put several data sources into one powerful package (SCADA, CDAS, GPMS and manually entered lab data). Used in the correct way I believe it has also brought operations and maintenance a little closer together. "

Shaun Sanders Ratcliffe

Thank You