



## **icon-SL2 Gas Turbine Remote Monitoring Service**

**Unlock your turbine control system and declare *independence*  
.... Freedom with No Limits**

<b>Function</b>	<p>icon-SL2 Gas Turbine Remote Monitoring System gathers high resolution operating data and makes it available to EthosEnergy staff for monitoring, analysis and reporting purposes.</p> <p>icon-SL2 eWon data collection integrates easily into any existing modern control system. The functionality and operation of the gas turbine does not change.</p>
<b>Purpose</b>	<p>icon-SL2 Gas Turbine Remote Monitoring System provides an enhanced insight into your gas turbine operations.</p> <p>icon-SL2 solution requires no machine intervention to install and is a cost effective way to increase machine availability, reliability and increase the life cycle value of your assets.</p>
<b>Ownership</b>	<p>EthosEnergy Light Turbines developed the icon-SL2 Gas Turbine Remote Monitoring System using industry standard and best in class software and hardware.</p>

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## 1. OVERVIEW

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EthosEnergy has developed the icon-SL2 Gas Turbine Monitoring System to meet the requirements for customers requiring regular condition reports and performance updates on their gas turbine machinery provided by a team of turbine professionals. The objective of this service is to provide improved operational insight and peace of mind to the user.

This will allow operators and customers to **see more, know more and do more** with their assets.

The System provides improved diagnostic capability and equipment operation. Years of industry maintenance and operating experience on a wide range of turbine technologies enables EthosEnergy to facilitate proactive remote data access and analysis to turbomachinery related problems. Operational data is used with a focus on improving customer-specific business value over the life time of the turbine.

EthosEnergy leverages both centralized and global technical expertise to proactively quantify operational parameters and ensure efficient operation and troubleshooting capability.

## 2. APPLICATION

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The icon-SL2 Gas Turbine Monitoring System can be deployed to any turbine along with its driven unit and associated balance of plant. The system can be configured for any turbo-machinery application.

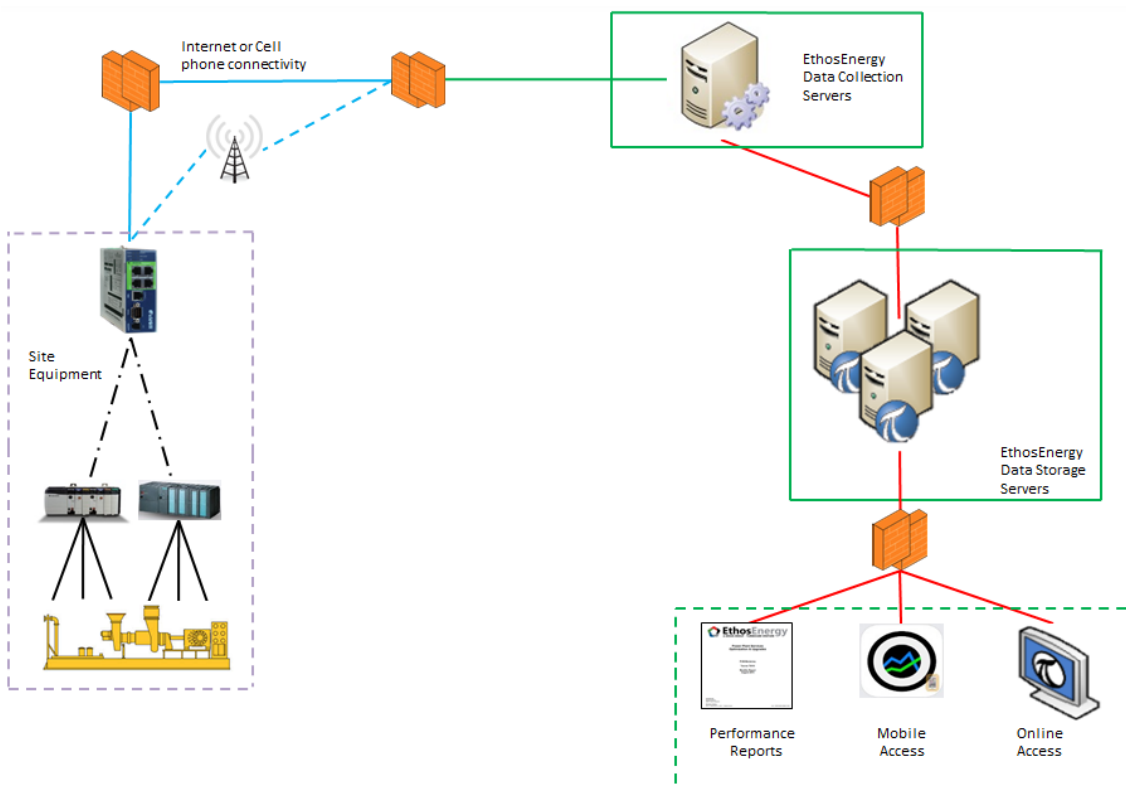
The system has been designed to be end unit agnostic, this allows icon-SL2 to be implemented on any turbine type or package with a modern PLC.

EthosEnergy provide Basic and Premium services routinely to operators of the following standard Solar and Siemens gas turbine packages.

- **Solar**
  - **Centaur 40**
    - T4000 to 4700 models, generator or mechanical drive
  - **Centaur 50**
    - T5500 to 6200 models, generator or mechanical drive
  - **Taurus**
    - T7000 to 7900 models, generator or mechanical drive
  - **Mars**
    - T12000 to T16000 models, generator or mechanical drive
- **Siemens**
  - **TB**
    - TB4000 to TB5400 models, generator or mechanical drive
  - **SGT-100 (Typhoon)**
    - All models, generator or mechanical drive
  - **SGT-200 (Tornado)**
    - Intro and uprate models, generator or mechanical drive
  - **SGT-300 (Tempest)**
    - Intro and uprate models, generator or mechanical drive
  - **SGT-400 (Cyclone)**
    - Intro and uprate models, generator or mechanical drive

### 3. ARCHITECTURE

#### System Architecture



The remote data access system leverages existing site infrastructure to the greatest extent possible. In most cases the existing control system and local area network (LAN) interface will allow adequate access to equipment operating data.

Data is sampled every other second by a router installed in the field, then transmitted and appended on an incremental basis to the EthosEnergy Data Storage Center (DSC). A temporary VPN IPsec is initiated for data transmission. Communication is unidirectional from the turbine site to the FTP site; data is streamed into the proprietary OSIsoft PI Universal Data Server, the most powerful time-series database available.

Within our servers data is computed according to complex algorithms to allow multi-faceted analysis of normalized performance data. This raw data and analysis output is trended and can be accessed with powerful analysis tools to enable both EthosEnergy data analysts and our customers to view. Data is typically collected at 2 second intervals; the PI system utilizes sophisticated data compression algorithms to facilitate rapid data retrieval and display.

Once stored the data is available for analysis by the Remote Monitoring and Diagnostic team as well as viewing by the end customer.

## Hardware Requirements



Ethernet	4x 10/100Mb (LAN)
Field Interface	1x MPI/Profibus (S7)
Input / Output	1x DI, 1x DO
WAN Connectivity	LAN
Integrated modem connectivity	y=1 : No Modem y=4 : PSTN y=A : HSUPA Global
Alarming	Yes
Data logging + Web HMI	Yes
Power Supply	12-24 V DC +/-20%, SELV
Temperature range	-20°C to +70°C
Marking	CE, cCSAus
Warranty	18 months

The eWON CD industrial router provides dual LAN/Modem connectivity to access remote machines and assets through the Internet. Installation and cabling are included in icon-SL2 supply.



The eWON 2005 CD or 4005 CD uses an outbound connection across the factory LAN (HTTPS port 443 or UDP 1194). No IT/firewall changes are needed to establish communication. A key asset that your IT team will appreciate!



All connections run through industry standard VPN protocols to guarantee a safe and secure connection that prevents network intrusions.



*As an option* WiFi and cellular modems allow Internet connectivity while avoiding a connection on the factory/corporate LAN network.

Using the eWON 4005 CD, continuous data logging and buffering can be performed on every tag name. eWON stores tag data values (+ timestamp) in its internal memory. The data logging files are retrieved via HTTPS over an IPsec VPN.





## 4. icon-SL2 PRODUCT STRUCTURE

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### Description

An independent service delivered regardless of gas turbine make, model or control platform providing continuous machine health monitoring, informative and accurate reporting.

Providing customer web access to data displays and includes a rapid response to machine trips and alarm notification through attention from a dedicated equipment health manager.

### BASIC service

Delivery, installation and commissioning of the site hardware. Initial database and tag setup, performance algorithm configuration and report design and production.

Monthly data analysis report (DAR) delivery.

Customer web access (maximum three (3) users) – via any device anywhere to standard data displays.

Text and email alerting in response to icon-SL2 standard events.

6 year data storage to cover overhaul life of turbine

### PREMIUM service

Hardware delivery, installation and commissioning. Initial database and tag setup, performance algorithm configuration.

Monthly custom data analysis report (DAR) delivery

Dedicated Equipment Health Manager (EHM)

The EHM will consult with the customer during the development of the machine performance and condition analysis algorithms.

The EHM will consult with the customer to create a customized data analysis report and up to 3 additional data displays.

Customer web access (maximum fifteen (15) users) – via any device anywhere to standard and custom data displays including advanced trending and event frame viewing.

Remote access login to the icon-SL2 system to export historic data via excel for customer records or analysis as well as business or regulatory reporting.

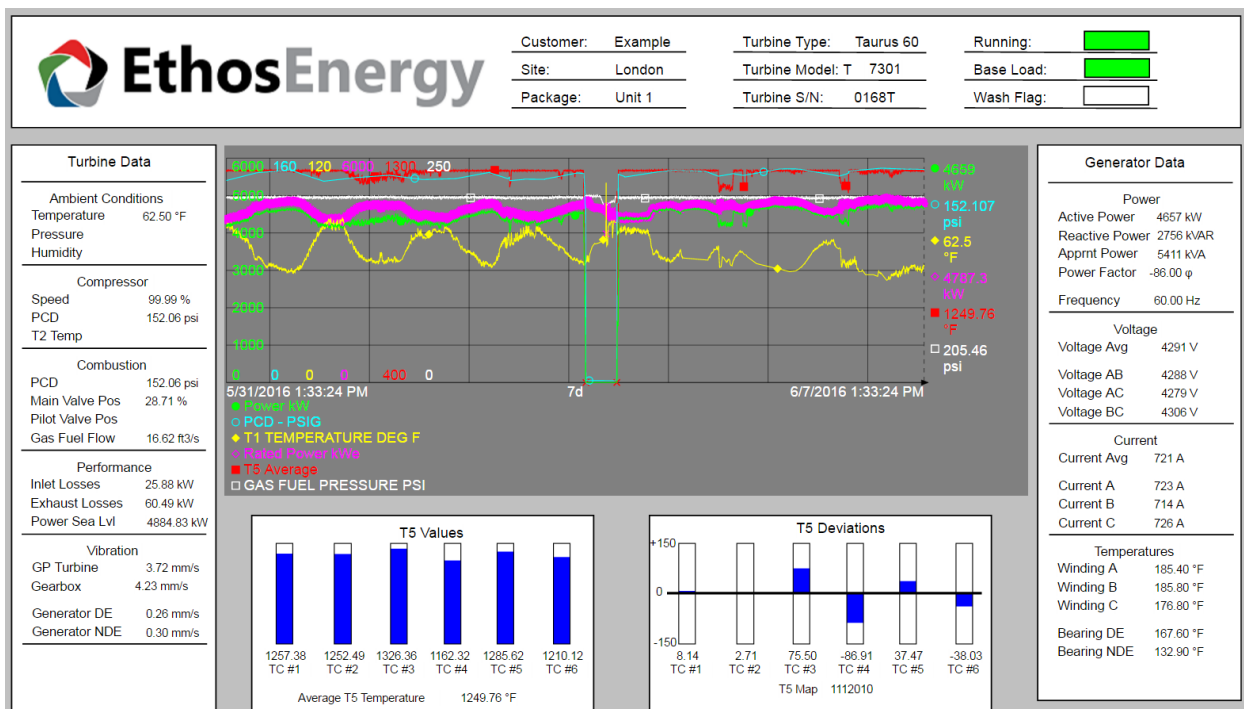
Ability to add additional data points for related processes and extended balance of plant equipment.

Unlimited data storage to cover life of equipment and plant

## 5. TYPICAL ANALYSIS METHODOLOGIES (can vary by site)

### Visualization of operating parameters

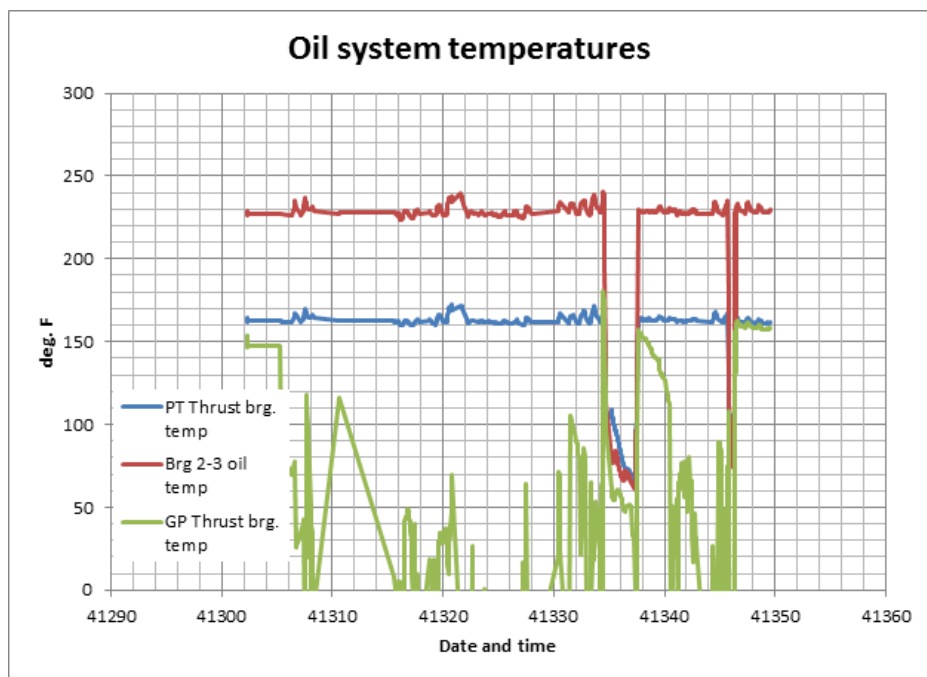
This dashboard allows for fast review of current and past operating data, including weather information and ambient parameters, from a remote location. The remote viewing is enabled by PI Coresight, an intuitive visualization tool that delivers fast, easy, and secure access to all your system data. System data is delivered to any modern web browser - no special client software is needed. It is also available on mobile devices.





## Trending main operating parameters.

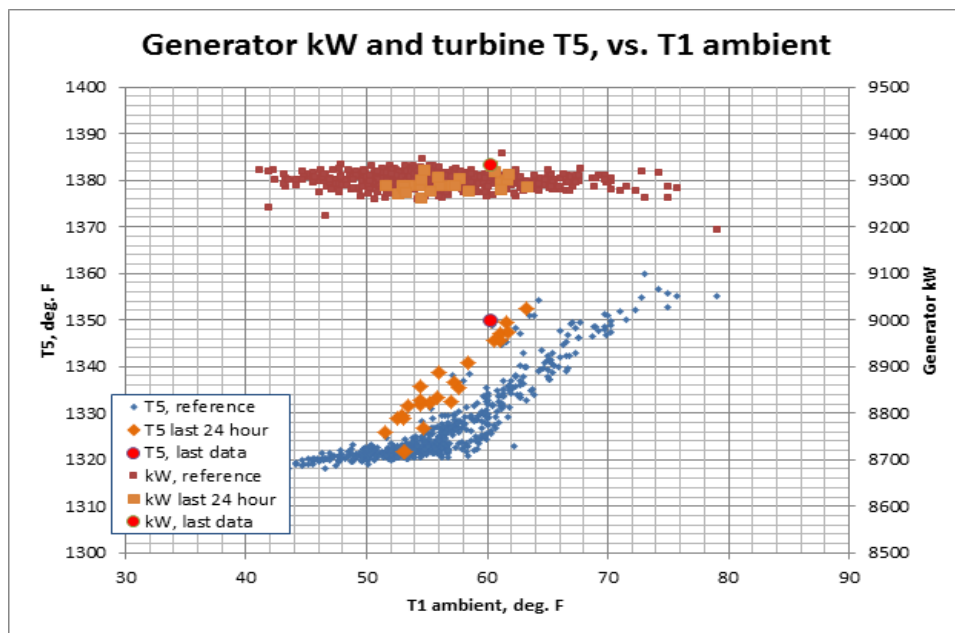
Regular analysis better ensures protection of equipment and optimal performance. In this example a transmitter problem was detected on the GP Thrust Temperature probe of a monitored turbine. The symptom was the erratic trend of that parameter. Trending will help identify system failures and provide better prognosis and protection against true risks.



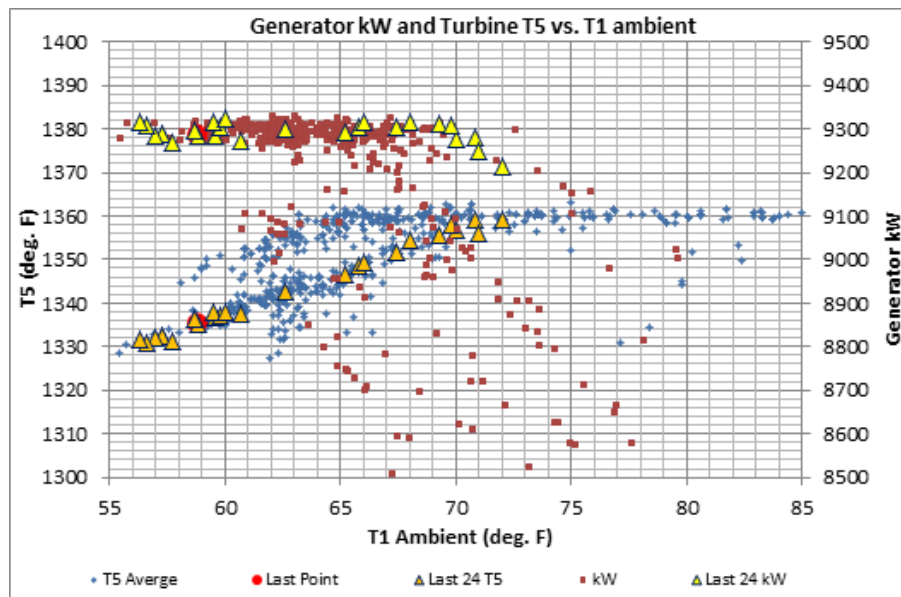
## Cloud plots of significant operating parameters.

Accurate performance characteristics can be cumulatively analyzed. In this example a shift in the operating line on one of the turbines monitored was detected. The shift was toward lower PCD and higher T5 and was identified on the cloud plot as a shift in the current operating line. The symptom in the field was less power for the turbine at temperatures above 65 deg. F. This proved to be a slight malfunction of an IGV actuator resulting in deteriorated performance. The problem was corrected and the operating line restored back on the correct pattern (the points after solving the problem are marked with triangles on the chart below).

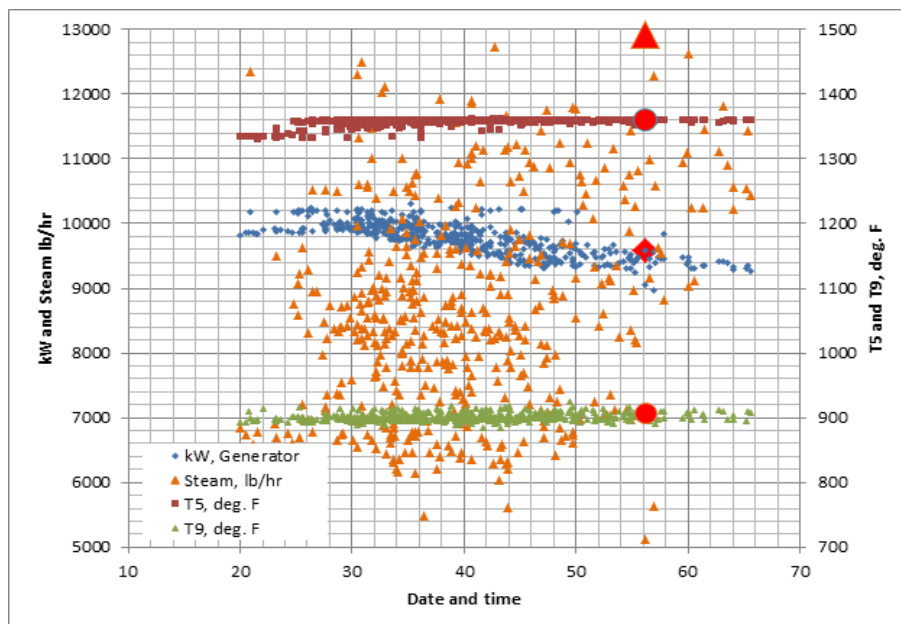
In the field this was seen as the turbine recovering the lost power up to the ambient temperature of 71 deg. F, which was the normal operation.



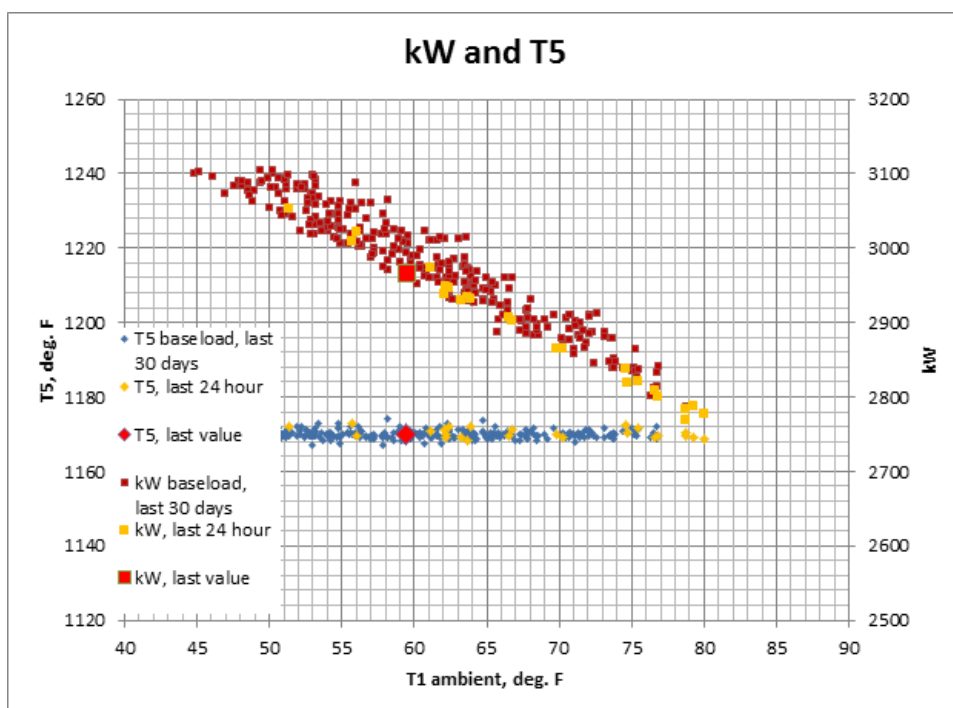
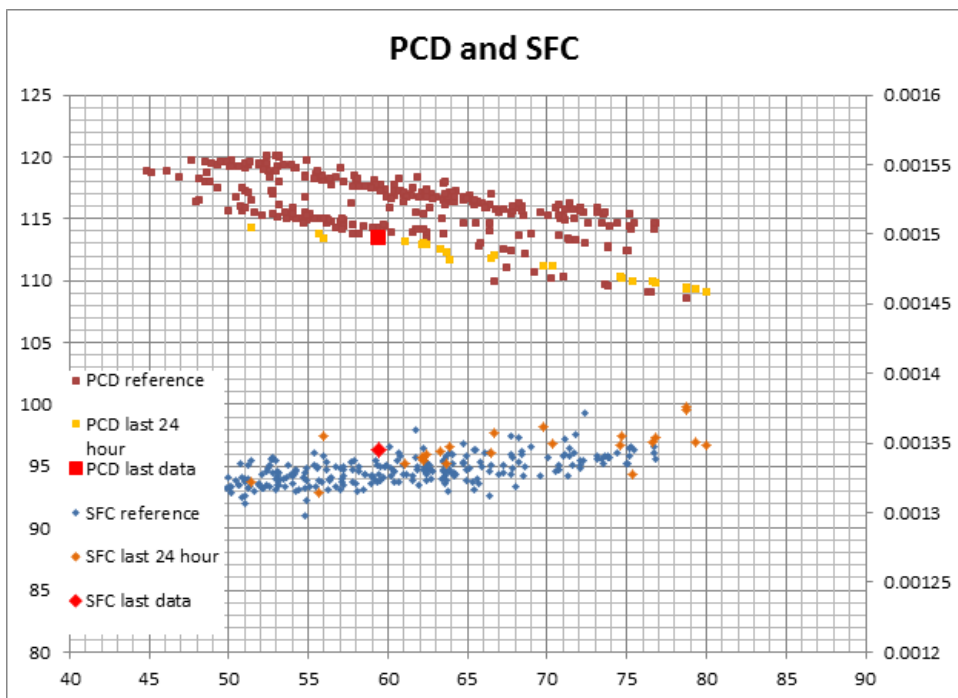
Plots with cloud points of main operating parameters can be maintained, with differentiation for reference periods (i.e. by month or day). The plots are designed to detect shifts in operating lines, to identify trends and corroborate site information.



In a similar instance at a combined cycle plant (gas + steam turbine), high variability in total electric power output was reported. The cloud plots revealed that such variation was due to high variability in steam turbine flow (up to 70%, as seen by the orange data below) and was not caused by problems with the primary gas turbine as reported by site.



In another example with an engine in a cogeneration plant, a shift in the power line, specific fuel consumption and PCD lines was detected (see plots below) and ultimately diagnosed as degradation within the compressor requiring more frequent water wash to maintain performance. The operating line was restored after the next compressor wash.





## EthosEnergy Profile

**EthosEnergy** is a leading independent service provider of rotating equipment services and solutions to the power, oil & gas and industrial markets. Globally, these services include power plant engineering, procurement and construction; facility operations & maintenance; design, manufacture and application of engineered components, upgrades and re-rates; repair, overhaul and optimization of gas and steam turbines, generators, pumps, compressors and other high-speed rotating equipment.

**EthosEnergy Light Turbines LLC** is the leading independent aftermarket service provider to Solar Turbine operators. These services include full Solar turbine overhaul and repair capabilities, control system upgrades, parts supply, field service provision and long term contract support of customers with mixed and multiple engine fleets.

We provide an extensive Exchange Fleet management service ensuring minimum site downtime for engine overhauls and repairs. All main and auxiliary gearboxes can be exchanged.

- + Complete overhaul of Saturn<sup>®</sup>, Centaur<sup>®</sup>, Taurus<sup>®</sup> and Mars<sup>®</sup> engines
- + Main and auxiliary gearbox overhaul
- + Full SoloNox<sup>®</sup> DLN capability
- + Full load, customer witness test capability
- + Extensive engine exchange fleet available
- + Engine repairs and upgrades
- + Field Service provision
- + Troubleshooting Activities
- + New Parts supply
- + Engineering Support
- + Remote Monitoring and Diagnostics



**SAFETY**

**SERVICE EXCELLENCE**

**PEOPLE**

**FINANCIAL RESPONSIBILITY**

**INTEGRITY**

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