BOILERWATCH® MMP-II-SSX

Acoustic Pyrometer - Simultaneous Sampling Bidirectional - Leak Detection

Distributor:

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Acoustic Pyrometer

The BOILERWATCH® MMP-II-SSX acoustic pyrometer is an advanced industrial instrument that provides fully automatic measurement of high combustion-gas temperatures, permitting fuel trimming control within heaters and boilers. The system is completely non-intrusive, and operates on the principal that the speed of sound in a gas is proportional to the temperature of that gas. Acoustic transceivers are mounted on the outside of walls of the heater/boiler, and a high intensity acoustic signal is launched through the gas stream. Since the distance between the sound source and receiver is known and fixed, the average temperature of the gas along the acoustic path is computed from an accurate measurement of the sound signal's transit time.

BOILERWATCH® MMP-II SSX Provides temperature measurement in groups of 5 paths. Increases speed of processing 80%. Also reduces air consumption 80%.

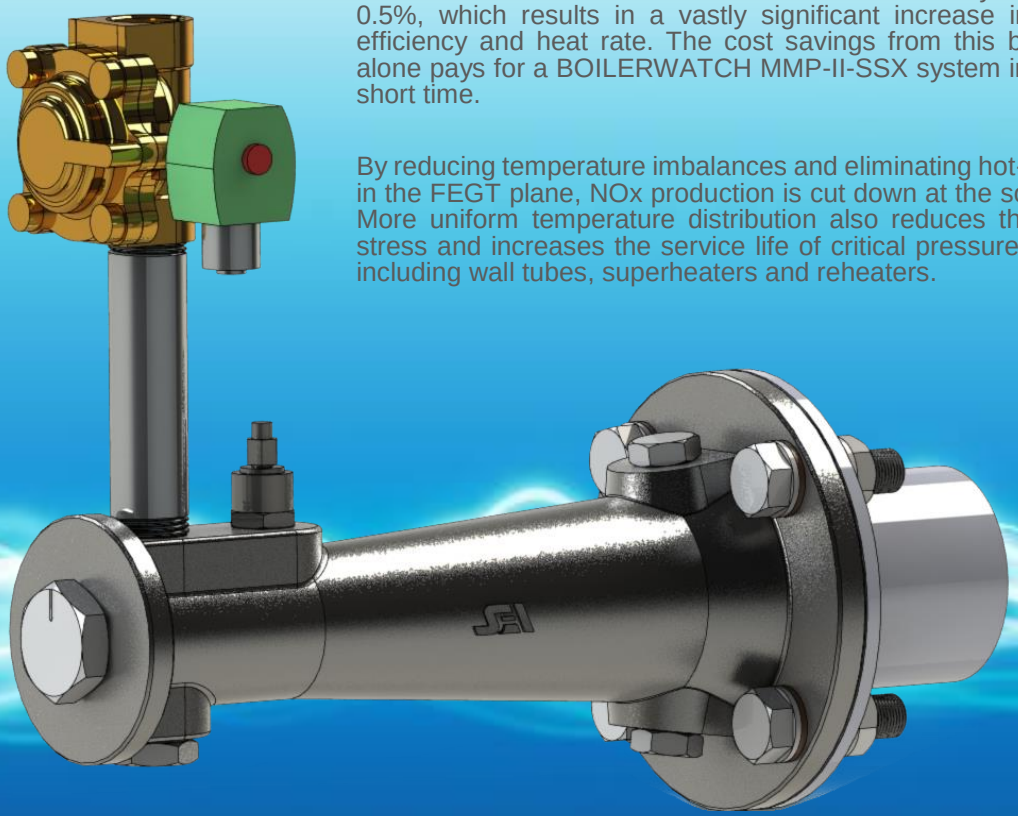
BOILERWATCH® MMP-II-SSX systems are available in a variety of configurations. With up to 24 individual path temperatures available, systems may be configured for spatial 2 dimensional temperature mapping, independent temperature measurements, or a combination of both. BOILERWATCH® MMP-II-SSX systems are easy to install, commission, and operate.

With our Acoustic Pyrometer you can measure the gas temperature in any kind of furnace or boiler and get a distribution map temperature, all in real time. The waveguide can be located in 2, 3 or 4 wall of the furnace or boiler.

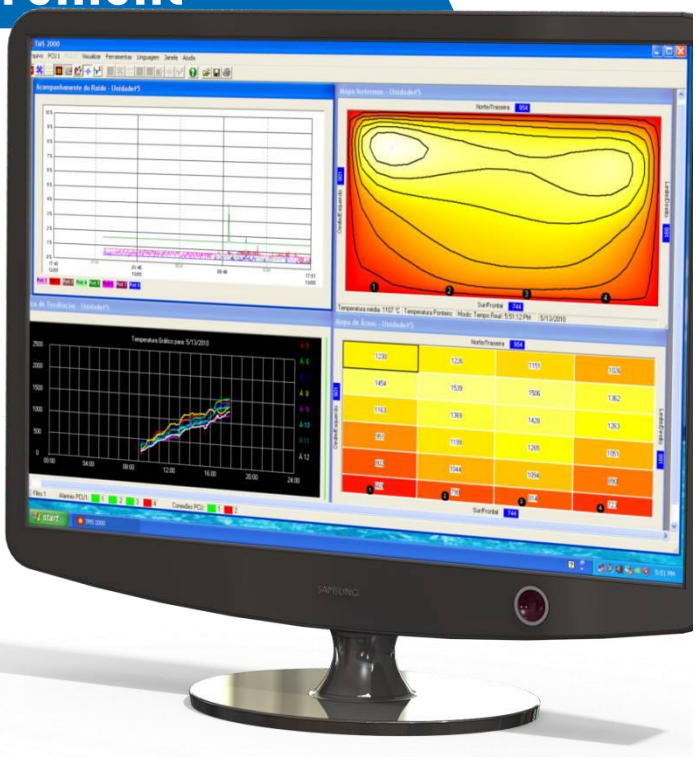
Using real-time gas temperature and spatial temperature distribution profile maps from a BOILERWATCH MMP-II-SSX Acoustic Pyrometer System to reduce out-off balance gas temperature conditions within the horizontal furnace exit plane of a coal fire power boiler, provides a number of highly cost effective benefits.

It has been shown that excess O2 can be reduced by at least 0.5%, which results in a vastly significant increase in fuel efficiency and heat rate. The cost savings from this benefit alone pays for a BOILERWATCH MMP-II-SSX system in very short time.

By reducing temperature imbalances and eliminating hot-spots in the FEGT plane, NOx production is cut down at the source. More uniform temperature distribution also reduces thermal stress and increases the service life of critical pressure parts including wall tubes, superheaters and reheaters.



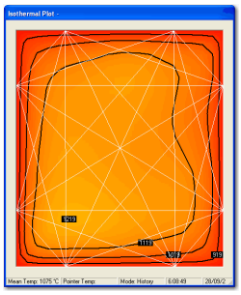
Software
Gas Temperature Measurement



TMS-2000 presents powerful visual information on real time or historical gas temperatures for temperature distribution within a furnace or combustion process. Spatial temperature distribution profiles, individual path temperatures, temperature trends, and average gas temperatures within user-defined areas are all quickly and easily available.

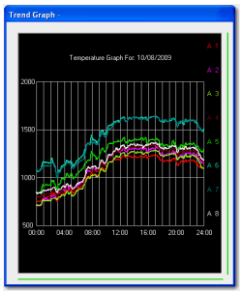
TMS-2000, like all of our software is menu driven for ease of use. In addition, it has soft key buttons to quickly move between screens, or to open and close screens.

Isothermal Map



TMS-2000 provides an accurate and clear picture of this temperature distribution profile in real time. The Isothermal Map Screen presents spatial temperature information as a series of isothermal lines and is color- coded. In addition, a digital readout of the temperature at any point on the map is obtained by simply moving the mouse cursor over the map display. For example, the screen layout below was made just by clicking on the soft key buttons.

Trend Graph

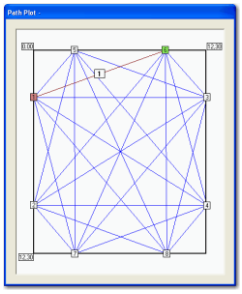


Path temperature graphs show up to 8 Areas and/or path temperature values. Both minimum and maximum temperature scale values may be selected for optimum resolution of the trace display. Time periods may be selected from the previous 24 hour periods up to 365 days. Each pen is color coded, any pen may be assigned to the first 8 paths and/or areas. The Time and Temperature are displayed by moving the mouse over the graph.

Area Map

TMS-2000's Area Map feature allows you to define up to 24 areas within the mapping plane, and automatically computes the average temperature within each area. There is considerable flexibility in defining areas, as they can be anywhere in the plane and need not be adjacent. Areas may be isolated or overlapping.

Path Plot



The path screen displays the locations of the Model 3020TR acoustic transceivers around the perimeter of the mapping plane and all of the available paths in the mapping array. Detailed information on any path, such as transmitter and receiver port numbers, path length, and other settings are available at the Tools Menu.

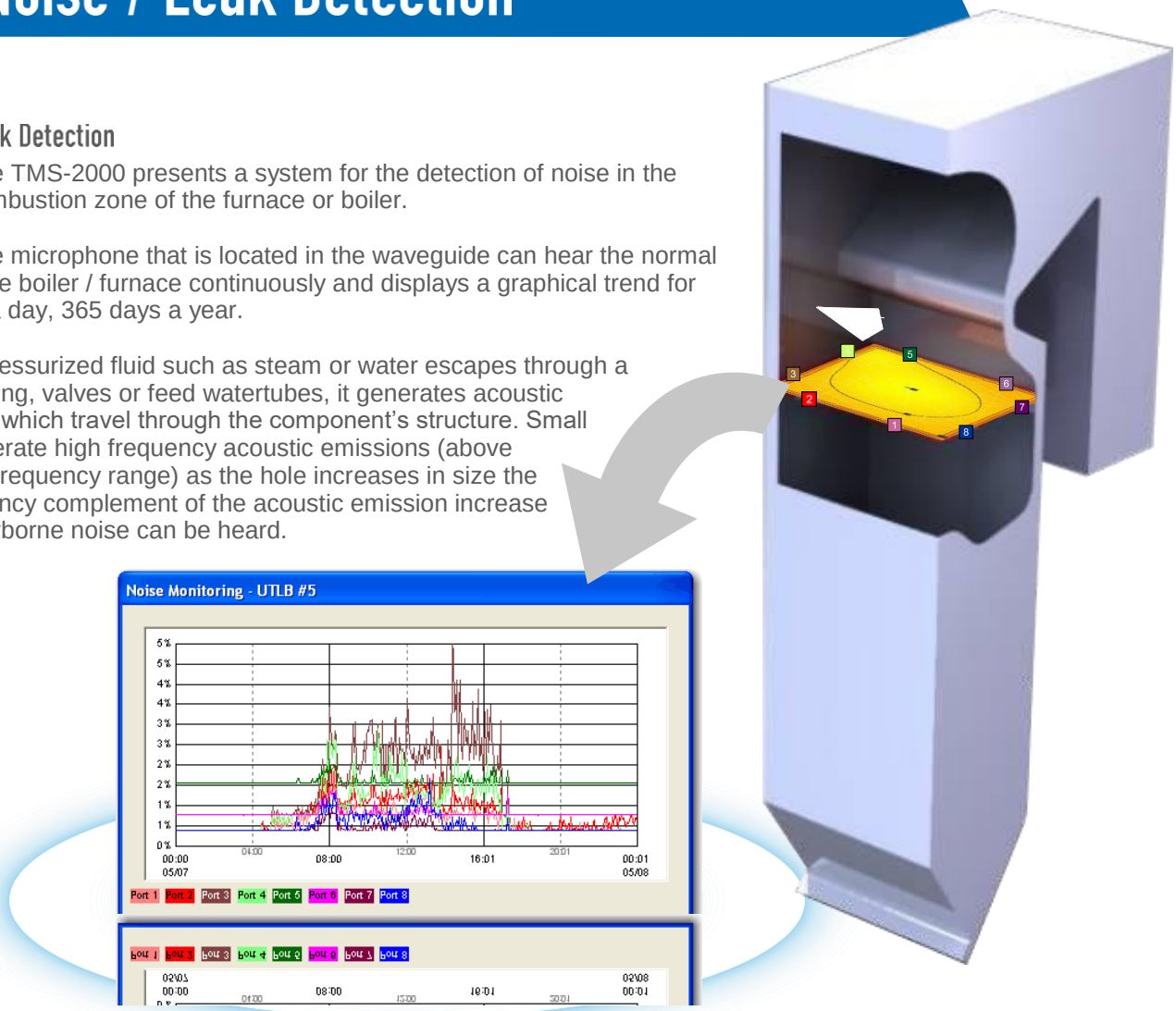
Software
Noise / Leak Detection

Noise / Leak Detection

The TMS-2000 presents a system for the detection of noise in the combustion zone of the furnace or boiler.

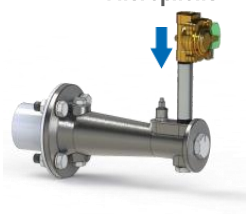
The microphone that is located in the waveguide can hear the normal noise of the boiler / furnace continuously and displays a graphical trend for 24 hours a day, 365 days a year.

When a pressurized fluid such as steam or water escapes through a leak in piping, valves or feed watertubes, it generates acoustic emissions which travel through the component's structure. Small holes generate high frequency acoustic emissions (above the audio frequency range) as the hole increases in size the low frequency complement of the acoustic emission increase and the airborne noise can be heard.



BOILERWATCH® MMP-II-SSX with Leak Detection may be used to detect early boiler tube leak to avoid secondary damage to pressure parts. Boiler acoustic tube leak detection system must be used as it prevents damage to costly boiler parts and it is very much cost effective.

Microphone



Traditional leak detection system such hearing hissing sound by ear or monitoring feed water flow or furnace vacuum is not much reliable because it cannot detect small leak so damage to vital costly equipment of boiler may not be avoided. Operators noticed many instances where thermal power plants boiler allowed to run for long time due to confusion which caused permanent damage to many boiler tubes, refractory and boiler structures. Hence importance of acoustic monitoring leak detection systems sincerely felt.

Early detection by BOILERWATCH® MMP-II-SSX with Leak Detection results in substantial reduction of repair times and costs with a consequent increase in plant availability and profits. The early detection of a boiler tube leak will give financial savings which will easily exceed the initial capital cost of the detection system even at the very first event.

Components

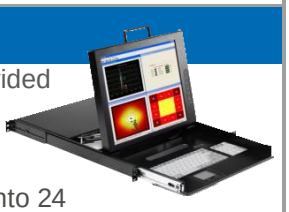
1 3020TR-SSL Transceiver Unit · Wave Guide and Preamplifier

Pneumatically driven acoustic sound source and receiver. Mounts on exterior furnace heater wall/observation door, and provides acoustic transmitter and receiver functions for balanced-draft furnace applications.

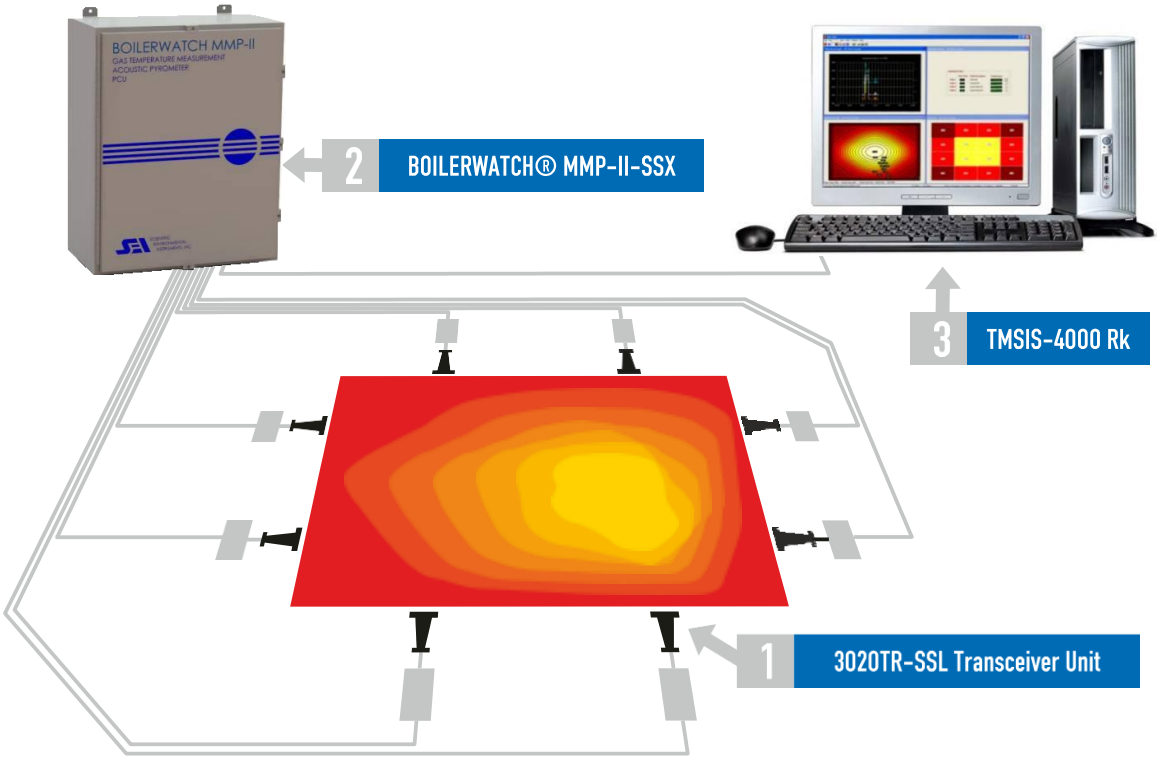
2 BOILERWATCH® MMP-II-SSX · Processor Control Unit (PCU)

Sound spectrum used for reliable detection is from 500 Hz to 3,500 Hz. Simultaneous detection is available to sample all paths in less than 15 seconds. Provides temperature measurement capacity for up to eight (8) independent paths (requires 2 model 3020TR Transceiver units per path), or up to a twenty-four (24) path array for spatial temperature distribution mapping (using up to 8 model 3020TR Transceivers).

3 TMSIS-4000 Rk



The TMSIS-4000 utilizes the TMS-2000 software to convert path temperature data provided by the BOILERWATCH® PCU into area data for planar temperature distribution mapping applications. The spatial temperature gradients are displayed in the form of an isothermal map and accurately represent a planar temperature gradients. Additionally, the complete two-dimensional (2-D) (planar) isothermal map is sectioned into 24 areas forming an array of area temperatures, which constitute a single spatial temperature plane. The area temperature data is then fed directly into the plant Distributed Control System (DCS), Data Acquisition System (DAS), for data presentation and archiving.



Specifications

1 3020TR-SSL Transceiver Unit · Wave Guide and Preamplifier

Wave Guide

Material:	Stainless Steel 316L
Dimensions:	200mm flange diameter, 325mm length
Flange:	In accordance with ASTM standard 3-inch 150 lb. pipe flange
Weight:	26 lb. (11,8 Kg.)
Temperature Environment:	Flange: +450ºF (+232ºC) max.; Ambient Air: +130ºF (+54ºC) max.
Noise generated:	Inside: 126dB.
Air Pressure to Sound Source	Air Service. 80 - 120 psig (5.0 - 8.3 Bar).
Air consumption	5 bar = 2.26 m3/min (No Constant)

Preamplifier

Ambient Air Temperature:	+ 140 ºF (60ºC) maximum, No solar loading on cabinet
Enclosure:	343H x 288W x 130D mm
Weight:	14 lb (6,4 Kg)
Industrial Standards:	NEMA/EEMAC Type 4. IEC 60529, IP66

2 BOILERWATCH® MMP-II-SSX · Processor Control Unit (PCU)

Ambient Air Temperature:	+ 130 ºF (54ºC) maximum, No solar loading on cabinet
Enclosure:	762H x 610W x 356Dmm
Weight:	110 lb (50Kg)
Industrial Standards:	NEMA/EEMAC Type 4. IEC 60529, IP66

3 TMSIS-4000 Rk

Number of Ports:	Two minimum and up to sixteen maximum
Number of Paths:	Up to twenty-four (24) paths
Warranty:	Two (2) years.

TMS-2000 Software

Measurement Range:	32ºF to 3500 ºF (0ºC to 1927 ºC)
Temperature Units:	English or Metric (ºF or ºC)
Accuracy:	Better than 0.5%
Measurement Acquisition Time:	Less than 30 Sec.
Data Output:	OPC/Ethernet
Data Saved:	Unlimited (Isothermal Map, Trend Graph and Noise Detection).
Remote Connection:	VPN or Remote IP.

Benefits

Startup Temperature:

Monitor flue gas temperature ramp from Ambient Temperature for boiler startup preventing overfiring that could damage superheat tubes, or underfiring that could potentially send wet steam to the steam turbine damaging buckets.

Soot Blower Control:

Record time vs. temperature histories to improve boiler performance and control of soot blower operation and duration. Monitor thermal transients during cleaning to improve heat transfer on boiler tubes from under cleaning which could lead to slagging conditions. Monitor boiler gas temperature for comparison to steam outlet temperature for determining soot blower activation.

Reduce Slagging / Ash Fusion:

Monitor maximum allowable temperature in the boiler superheat/reheat section for ash fusion alarm point annunciation.

Low NOx Applications:

Sense temperature set points between 1,600°F and 2,100°F for the injection of low NOx enhancers with urea or ammonia in Selective Noncatalytic Reduction Systems.

FEGT High Temperature:

Monitor highest temperature and maximum load condition for most efficient operation and prevent boiler waterwall, reheat and superheat tube failure.

Reduce Fuel Consumption on Startup:

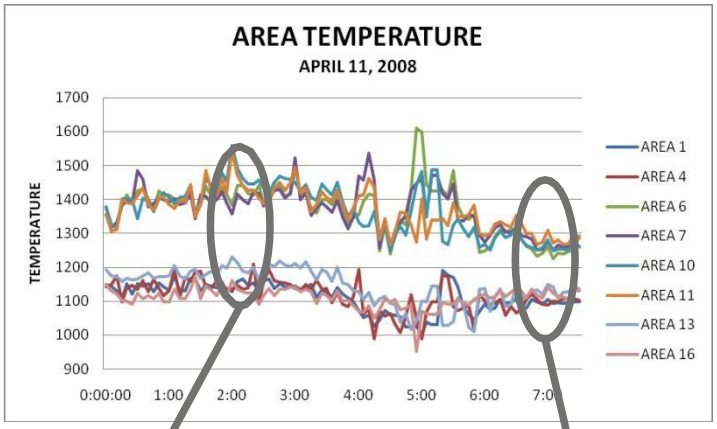
Monitor fuel changeover based on temperature rather than load, thereby reducing startup time by hours.

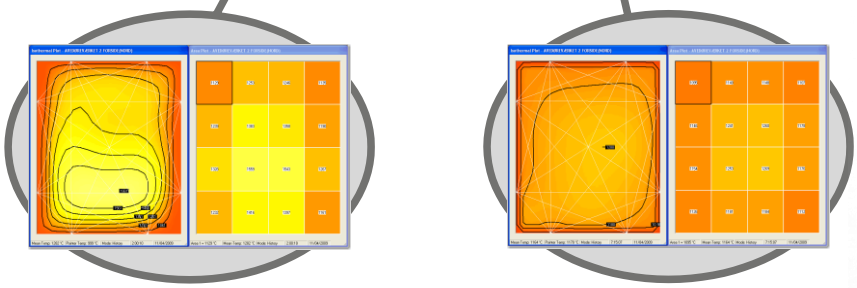
Fluidized Bed Boilers:

Determine optimal temperature for pulverized limestone injection on flue gas desulfurization systems and general operating conditions. Measure bed temperature for optimal operating efficiency.

DONG Energy Avedore – Denmark

SOOTBLOWER Control



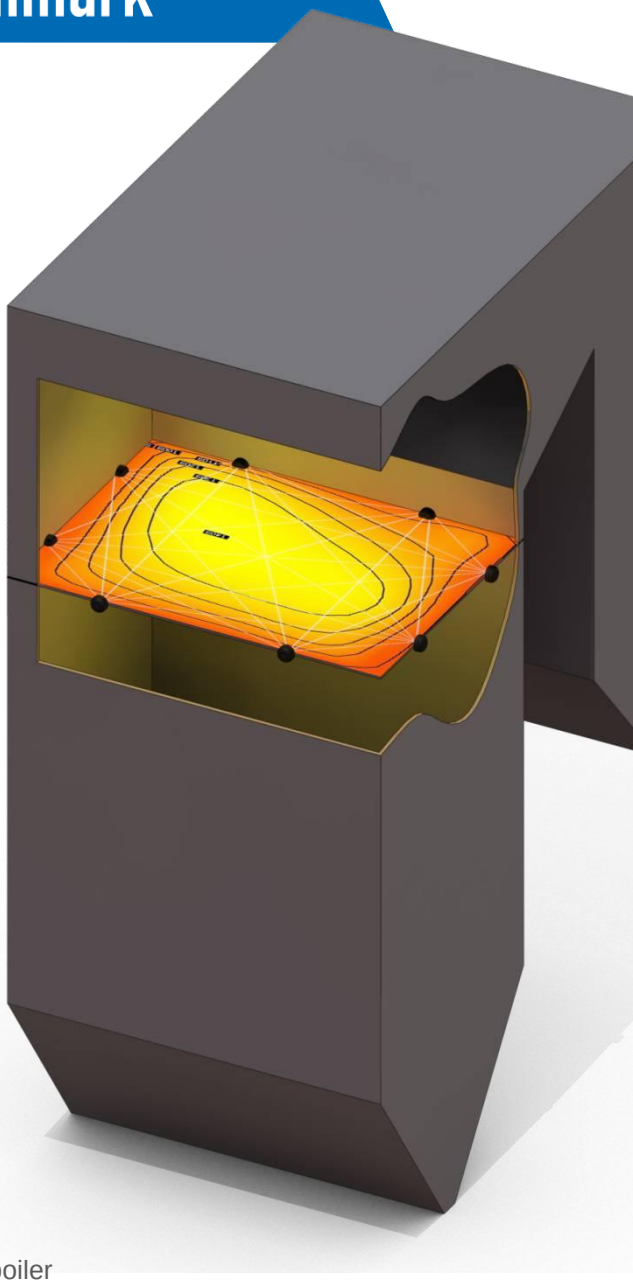


Time: 02:00 h
Max Temperature: 1559 ºC
Min Temperature: 1128 ºC
Mean Temperature: 1282 ºC

ΔT: 431 ºC

Time: 07:00 h
Max Temperature: 1268 ºC
Min Temperature: 1143 ºC
Mean Temperature: 1202 ºC

ΔT: 125 ºC



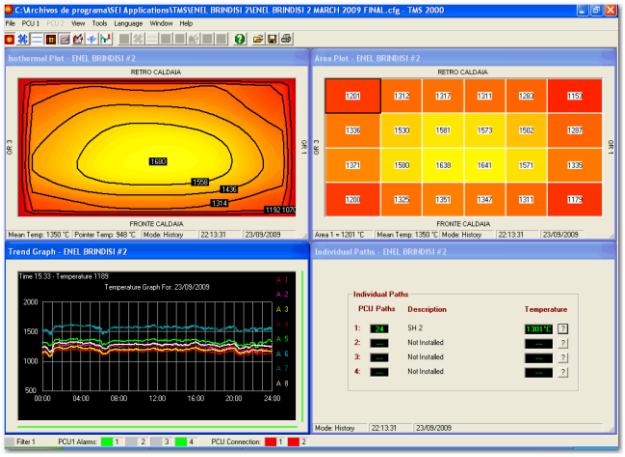
As fouling of the boiler increases and the rate of heat transfer decreases, peak temperatures increase, which increases NOx emissions.
Excess or unnecessary soot blowing can significantly reduce the boiler tube life and the net efficiency of the plant by wasting high temperature steam.

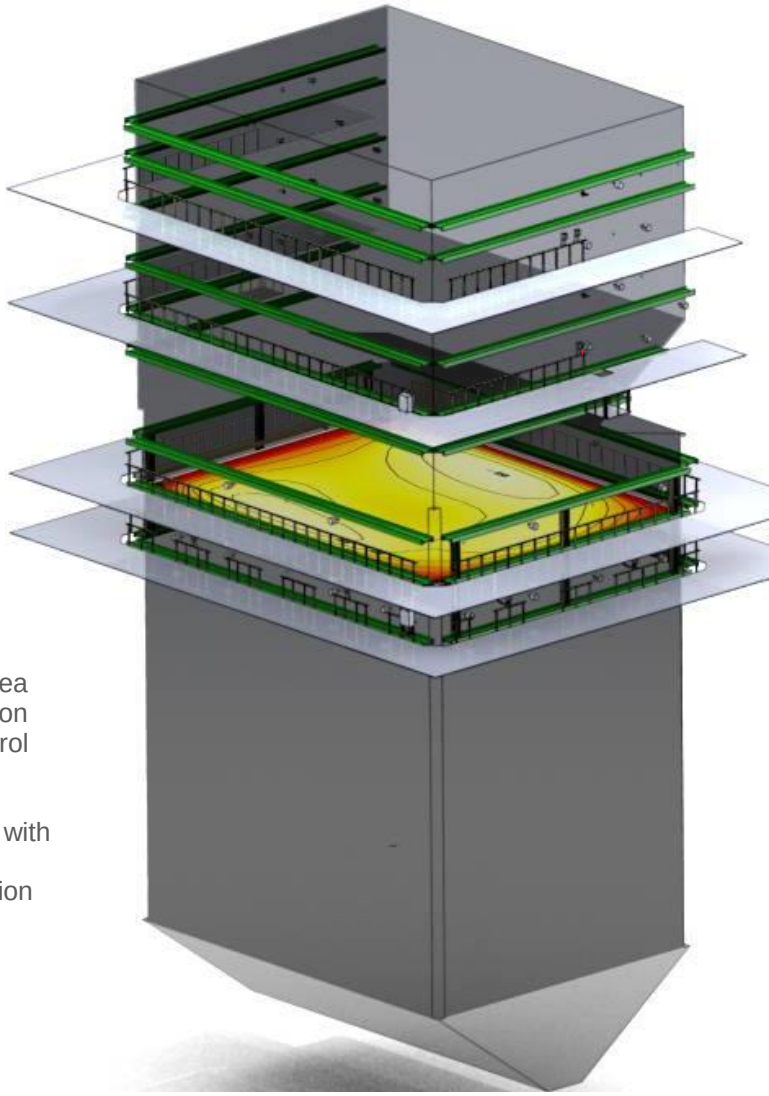
BENEFITS

* Sootblower Optimization.
* Thermal Stress Reduction in the Pipe Walls.
* Emissions Reduction/Combustion Quality.
* Reduction of High FEGT.
* Reduction of fuel consumption by improving Boiler Thermal Efficiency

ENEL Brindisi – Italy

TMSIS-4000 Rk
AT CONTROL ROOM





TMS2000 Software show the Isothermal map, Area Map, Trend Graph and Single path. The information on Area Map ans Single Map are sent to the Control Room through OPC Output.

The Isothermal Map below the nose is configured with 2 sensors per walls to obtain a 2 Dimentional gas temperature measurement for Chamber Combustion Control.

Single Path at Superheter is configurated with 2 sensors to obtein a main temperature to control superheater fireside ash corrosion and fireside corrosion fatigue.

BENEFITS

* Coal switched for a melting temperature close to 1300° C, before the coal used was mixed with other coals of the best quality.

* Increased flexibility in the supply market.

* Less bonds of carbon storage at the park and hence lower costs of logistics and handling.

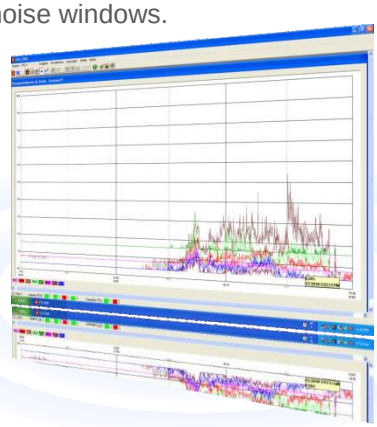
* Optimized blowing, less stress and less steam consumption of the equipment.

TRACTEBEL Energy Florianopolis – Br

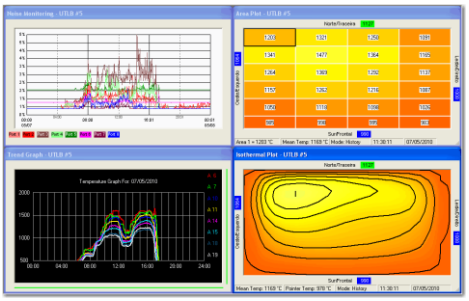
BENEFITS

Noise / Leak Detection

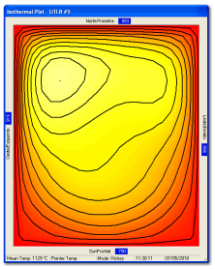
Our System detected a leak to the right wall and the sensors located next to the leak, are listening and showing in the trend noise windows.

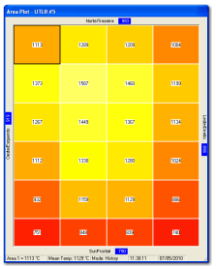


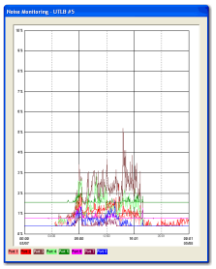
Startup Control Temperature.

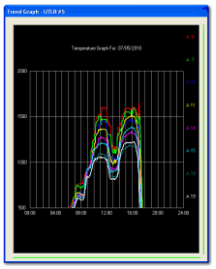


In the boiler startup, the system shown on the screen an isothermal maps, Area Graph Temperature and Noise Graphs Monitoring inside the boiler.
Our system detects a noise inside the boiler at increase the load and pressure of steam. The operator determines that it is a leak and the boiler must stop for inspection, verifying the leakage between port 3 and 4.

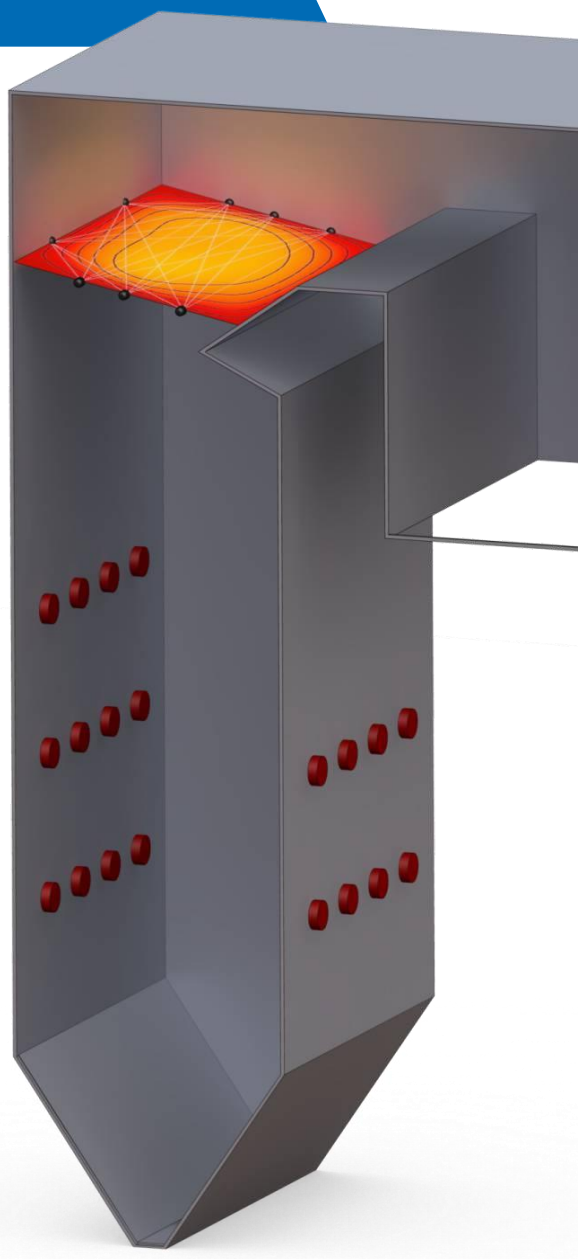






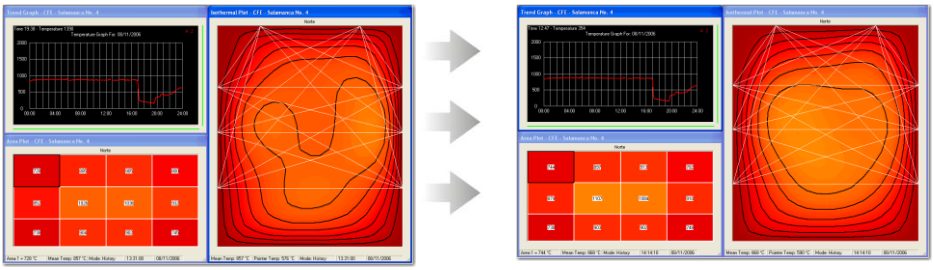


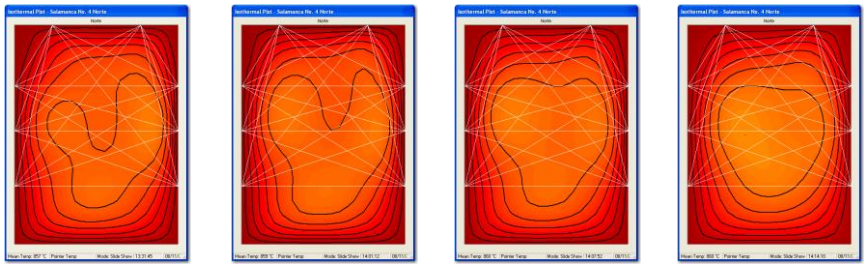
CFE Salamanca – Mexico



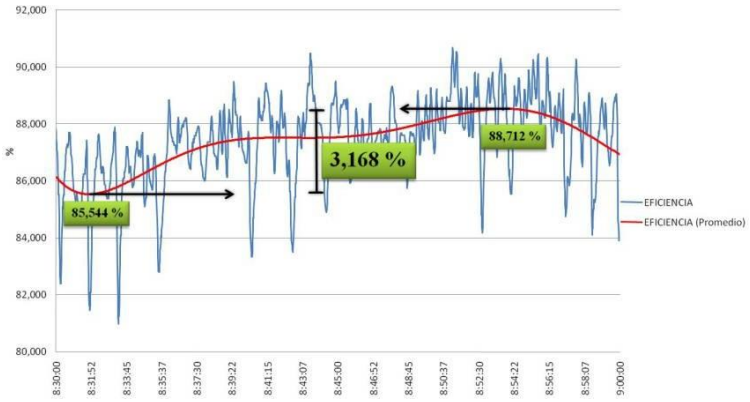
BENEFITS

Combustion Control





Combustion Control and Efficiency Increase

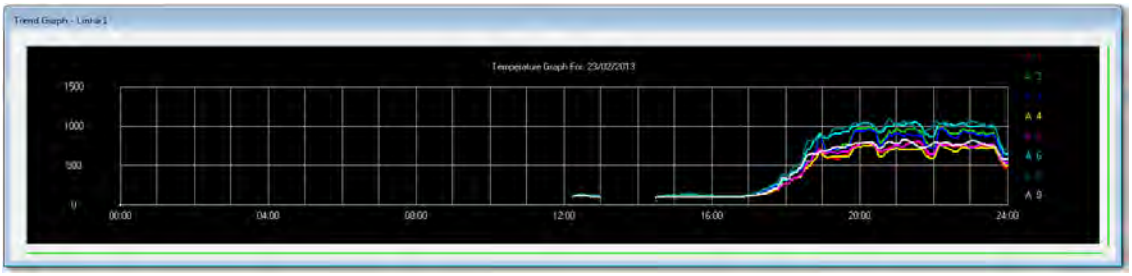


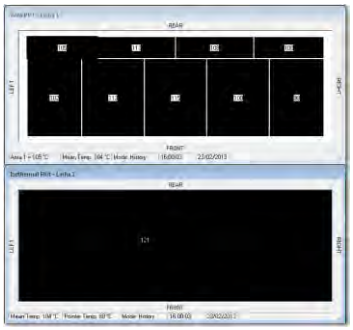
* Reduction of fuel consumption by improving Boiler Thermal Efficiency (3.9 %).
- Thermal Stress Reduction in the Pipe Walls and overall internal components of the boiler, due to displaying Hot Point development in Real-Time.
* Emissions Reduction/Combustion Quality.
- In the data compiled during the tests it was observed that manipulating the air flow and watching the display of a homogeneous isothermal chart it was possible to improve the emission of polluting agents.
* Improvement of the availability for service.
- By having control of the thermal distribution of temperatures, the production of hot points is not allowed, avoiding unforeseen needs to place the unit out of service, and therefore increasing the operating time of such unit.

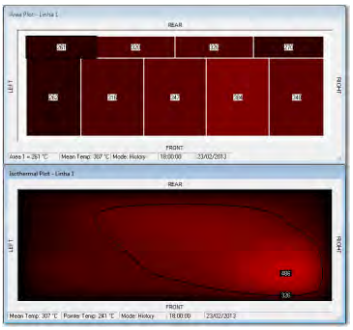
Boiler Start-up

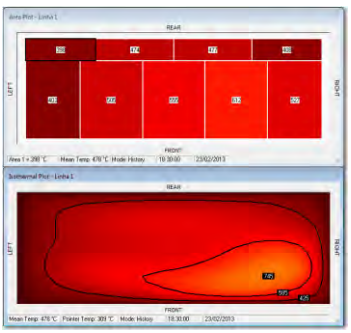
The Boiler Start-up

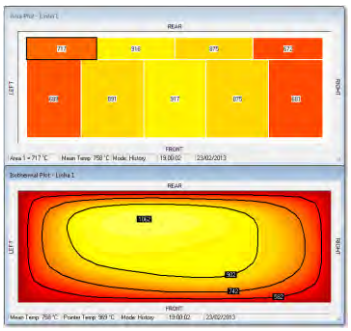
To prevent condensation of the flue gas, the Boiler and the Economizer require preheating before incineration is started.

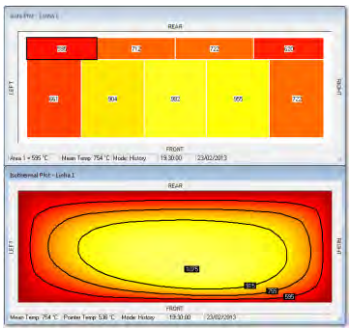


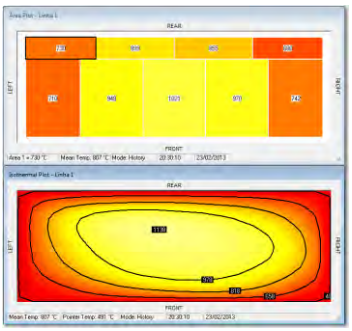


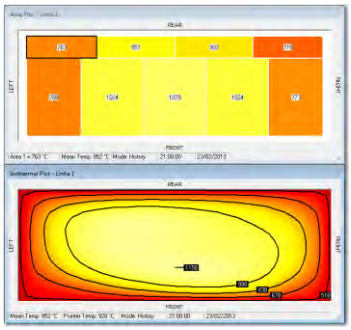


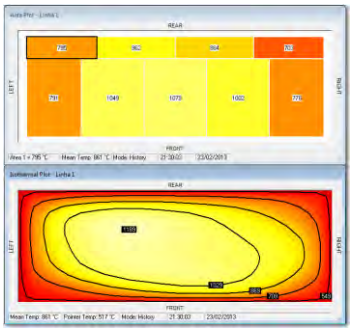


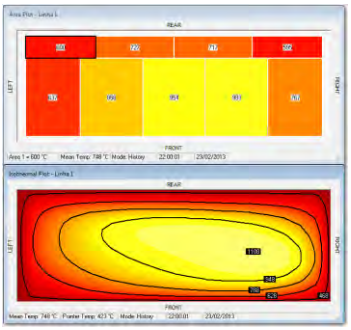




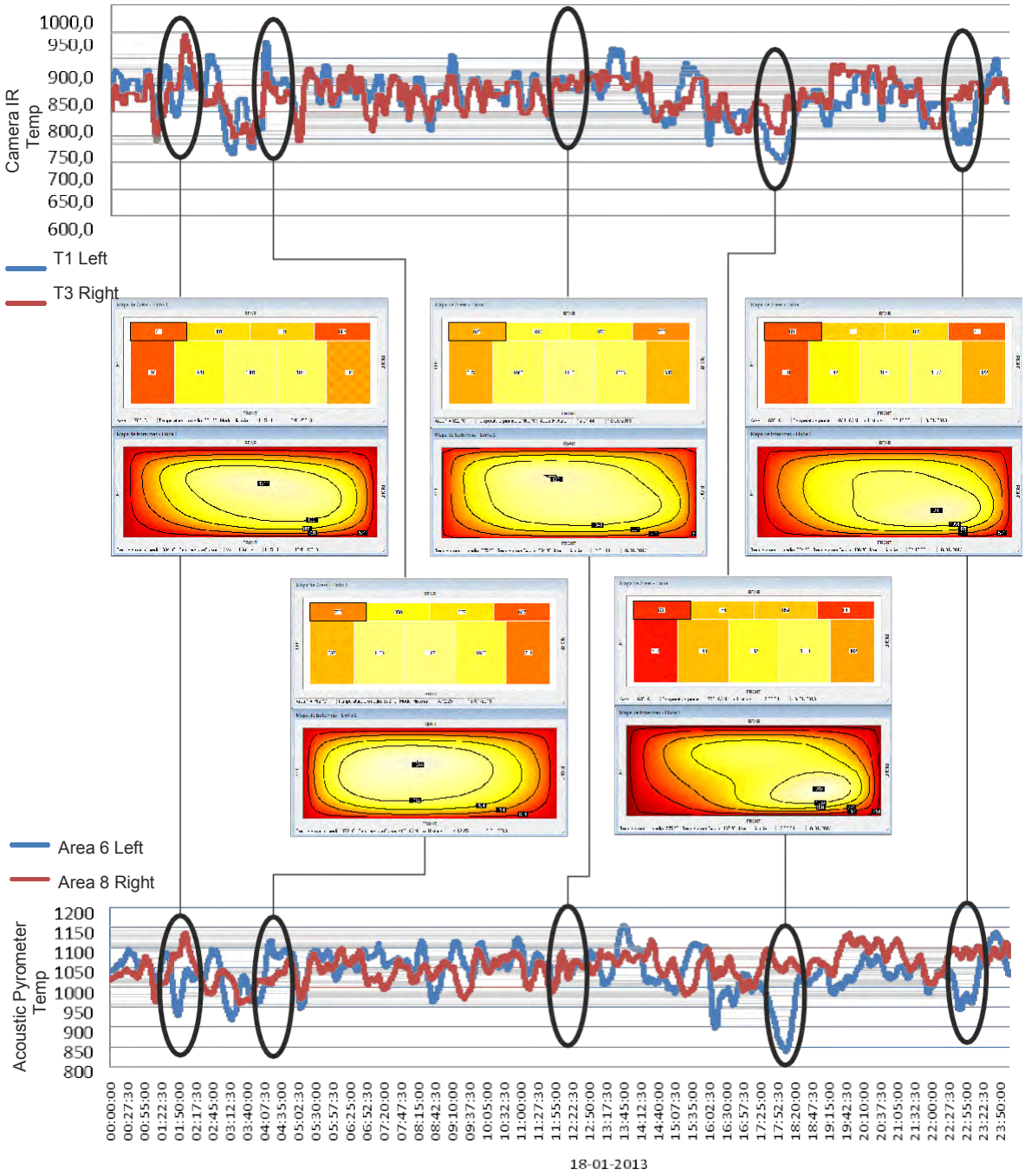








Gas Temperature Distribution



Depending on the fuel type, fuel distribution and air supply, temperature imbalances are typical. The common furnace exit temperatures measured by means of IR Camera and averaged can be used as reference temperatures to a limited extent only as these average temperatures do not say anything about the temperature profile or the imbalances within the injection levels.

The constantly varying composition of the fuel in waste incineration plants results, for instance, in rapid and major changes of the heating value and the ignition behavior of the fuel, causing considerable variations in the heat release and as a consequence the furnace temperatures. Moreover, the temperature window moves further upwards due to the increasing degree of deposits on the heating surfaces in the combustion chamber during operation.

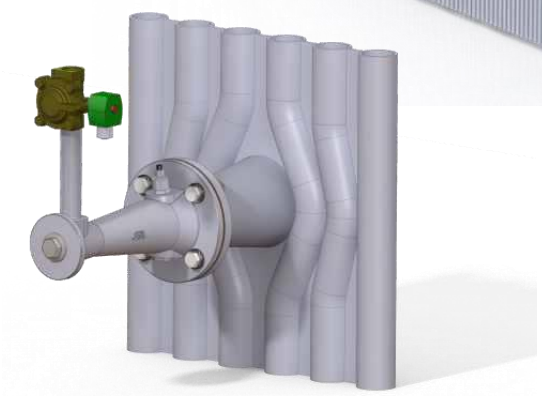
GESTAMP BIOMASS

WAVE GUIDE

PREAMPLIFIER

PCU

TMSIS-4000
CONTROL ROOM



Configuration:

6 Sensors 3020TR (2 on side walls and 2 on front wall) to obtain 12 trajectories per map.

GESTAMP BIOMASS

Localization:	Castilla y León
Power:	16,8 MWe
Fuel:	Forest
Energy Generation per Year:	130.000 MWhe
Tons of CO2 avoided:	100.000tons

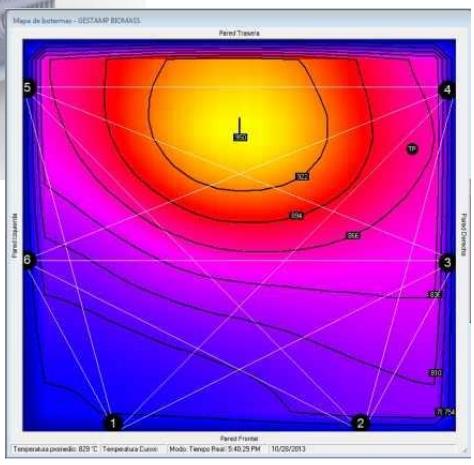
Optimize Availability

The main objective of the boiler design is to obtain high availability in operating hours. For this, the **BOILERWATCH MMP-II-SSX** Acoustic Pyrometry system has been installed to obtain a gas temperature distribution map throughout the boiler that avoids reaching the plastic temperature of the ashes and thus avoid adhesions and fouling . In turn, this temperature map is compatible with working outside the chlorine corrosion parameters in superheater banks.

The boiler is water-tube and will generate superheated steam from the combustion of forest residues and the recovery of heat from the gases. It is a radiant type boiler and in it all the evaporation takes place by means of heat transfer by radiation and convection on its membrane walls. These cavities are formed by a main hearth and a convective passage. This design reduces fouling of the boiler by minimizing the number of tube bundles inside.

The superheater bundle section is made up of tube banks with a spray-type intermediate tempering stage, to keep the temperature of the turbine superheated steam constant.

Finally, in the low gas temperature part, there is the economizer and air preheater bundle. The latter has a bypass on the air side to control the combustion air temperature.



Combustion

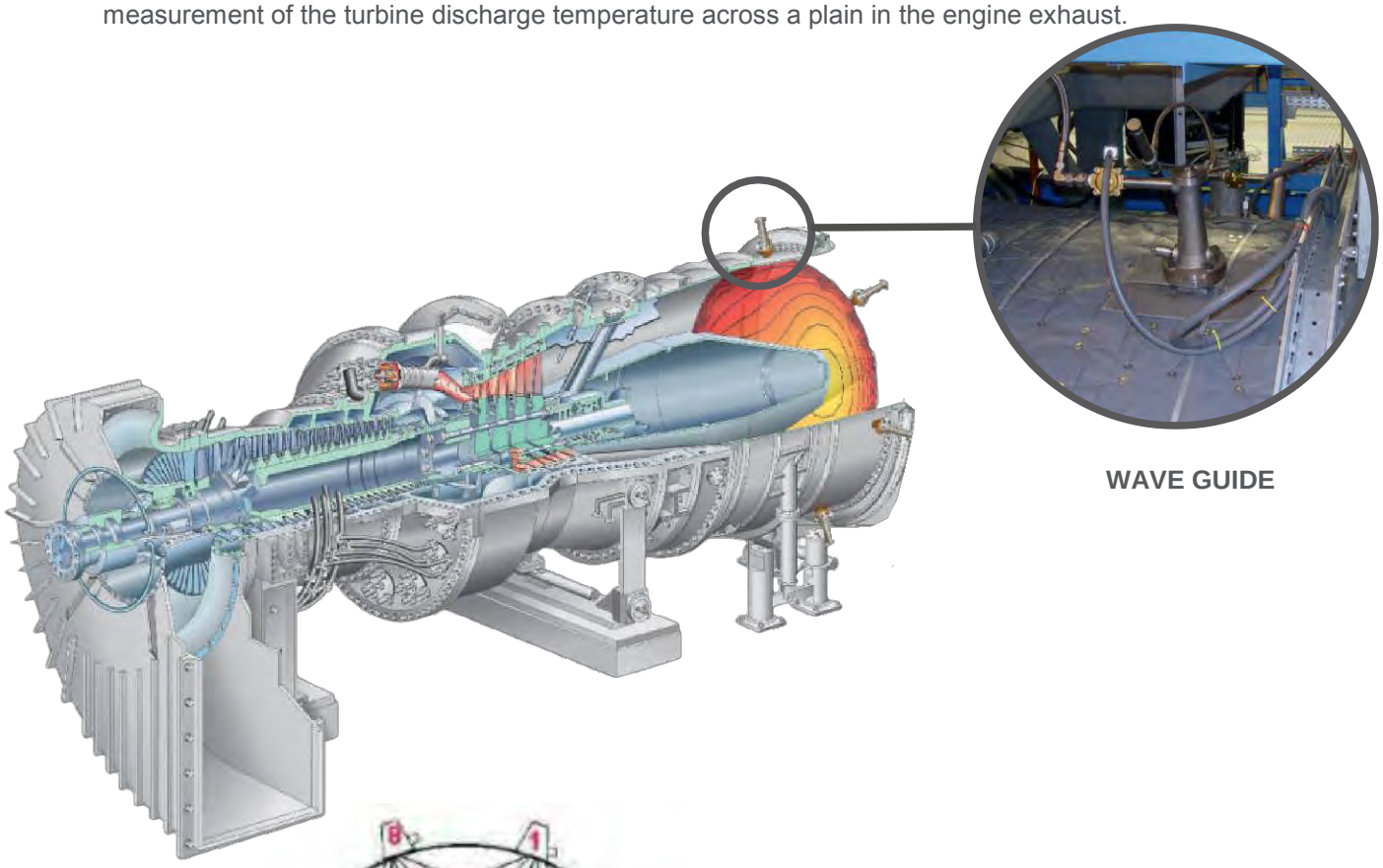
The combustion system is made up of a feeding silo with an anti-vault system, three high-capacity, low-speed extractor screws, three spreader-type biomass feeders and an air-cooled vibrating grill.

It has a complete primary and secondary air system with independent fans and regulation. It also has a gas recirculation system with which a high control of combustion and CO and NOx emissions is achieved. All these fans are driven by frequency inverters, which optimizes both their working point and the installation's self-consumption.

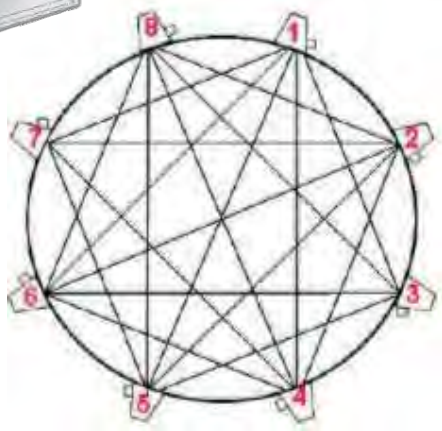
GAS TURBINE EXHAUST TEMPERATURE

The exhaust gas temperature (EGT) is typically defined as the gas temperature at the exit of the turbine; the sensors used to measure this parameter are considered the most vulnerable elements of the entire turbine engine instrumentation. EGT measurement is considered a key parameter for optimizing fuel economy, diagnosis and prognosis. The reason is that turbine blade temperature is a good indicator for normal life consumption of that blade. Currently, direct sensor measurements made on turbine modules are limited due to the extremely hot environment.

The acoustic pyrometer is a non-contact measurement device that obtains highly accurate instantaneous gas temperature data from any location within the turbine engine. An acoustic pyrometer measures the average gas temperature across a space of known distance, especially turbulent, high temperature gas. The goal of the SEI BOILERWATCH® MMP-II-SSX Acoustic Pyrometer System is fast and accurate measurement of the turbine discharge temperature across a plain in the engine exhaust.

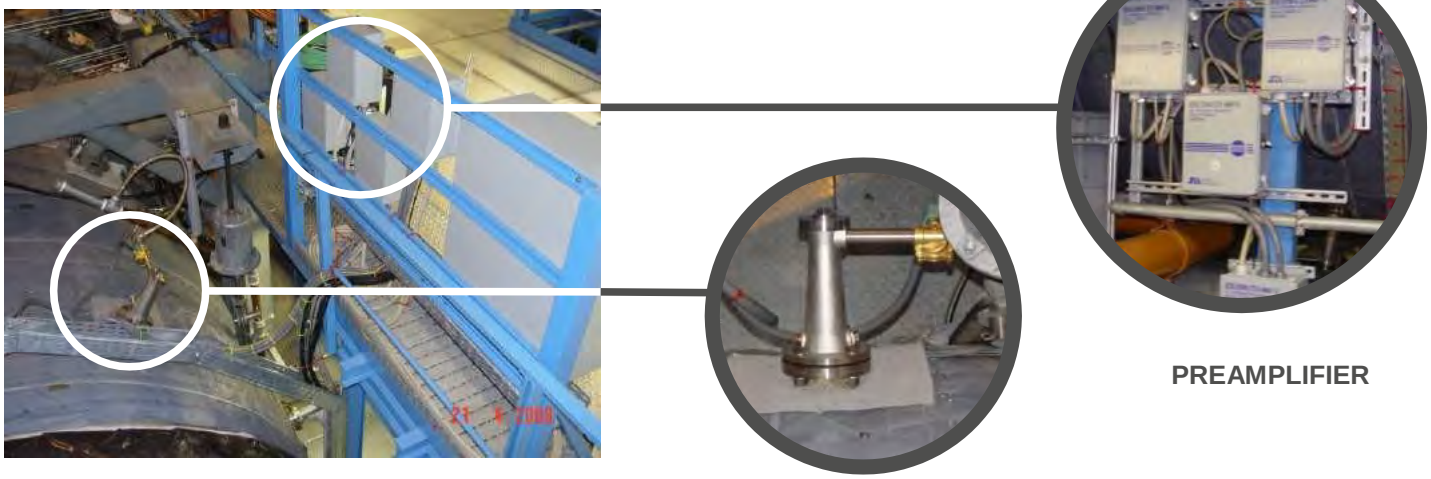


WAVE GUIDE



Eight sets of sound wave transmitters and receivers are placed equally spaced around the perimeter of the engine exhaust duct.

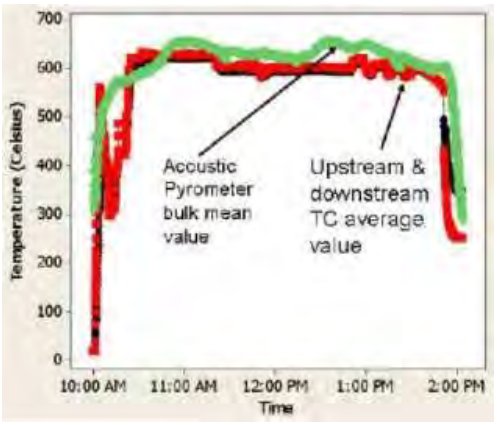
The transceivers were installed at the end of the exhaust diffuser approximately 5 diameters downstream at about a 1.5 times the exhaust diameter being the diameter at the cross section.

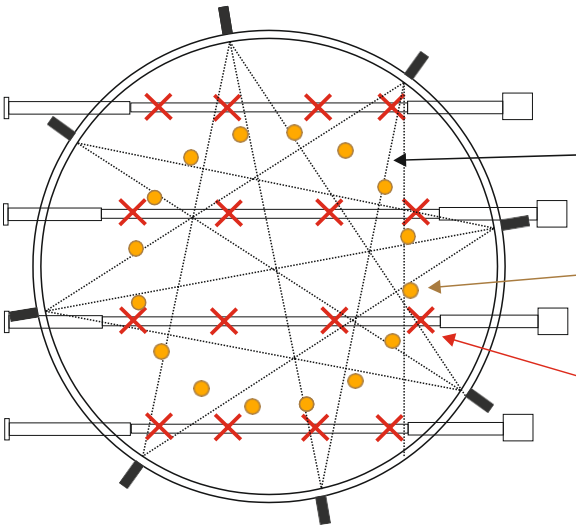


PREAMPLIFIER

WAVE GUIDE

For comparison there were thermocouple grids mounted on the exhaust on each side of the acoustic pyrometer plane. On the upstream station there were 16 thermocouples mounted on the same radial location symmetrically distributed around the cross section more than 1 diameter upstream. On the downstream location, there were 16 thermocouples mounted in a grid across the exhaust flow approximately 1.5 diameters downstream of the acoustic plane. A sample result obtained from this test is shown in the graphic. The graphic shows spatially averaged thermocouple data compared to spatially averaged acoustic pyrometer data.





Acoustic Path Lengths (x24)

Upstream thermocouples (x16)

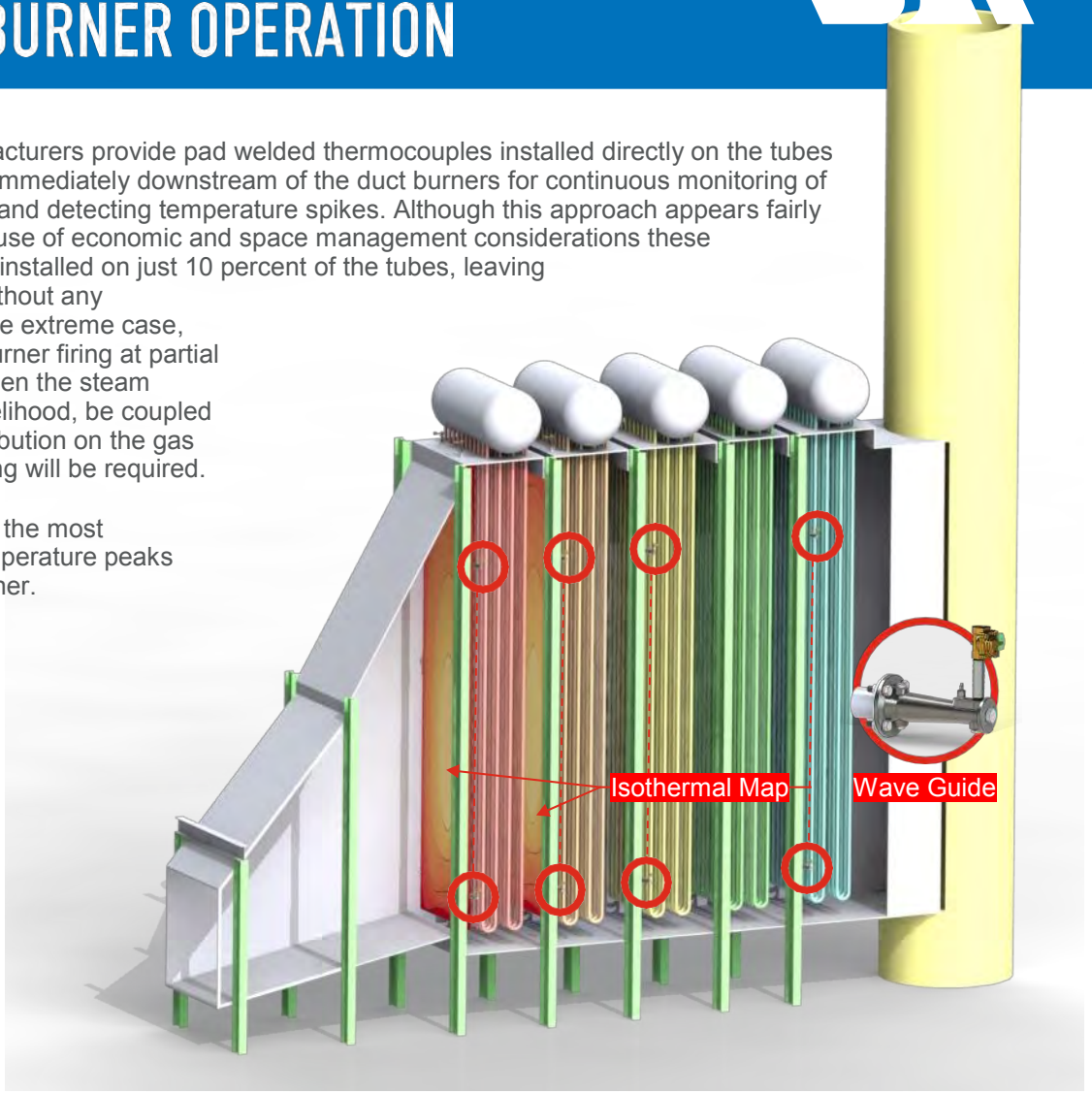
Downstream thermocouples (x16)

One issue with using thermocouples to measure EGT is associated with the fact that the thermocouple is immersed in the flow path. Turbine passages tend to be very small, which means that the cross sectional area available to the flow is limited. Thus immersing a thermocouple inside the gas path introduces a relatively large flow disturbance in the form of blockage. As a result, the thermocouple may be affecting the very quantity that it is trying to measure.

DUCT BURNER OPERATION

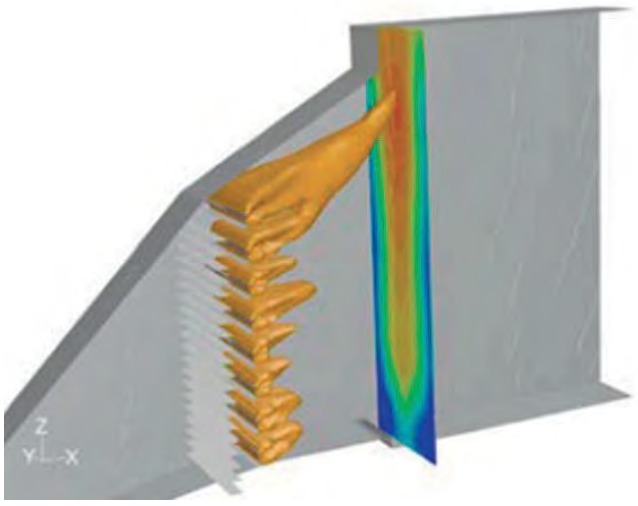
Typically, the HRSG manufacturers provide pad welded thermocouples installed directly on the tubes of the heat transfer section immediately downstream of the duct burners for continuous monitoring of the tube metal temperature and detecting temperature spikes. Although this approach appears fairly reliable at first glance, because of economic and space management considerations these thermocouples are typically installed on just 10 percent of the tubes, leaving the remaining 90 percent without any temperature indication. In the extreme case, such as 100 percent duct burner firing at partial combustion turbine load, when the steam maldistribution will, in all likelihood, be coupled with a temperature maldistribution on the gas side, more reliable monitoring will be required.

It is very important to obtain the most reliable indication of the temperature peaks downstream of the duct burner.

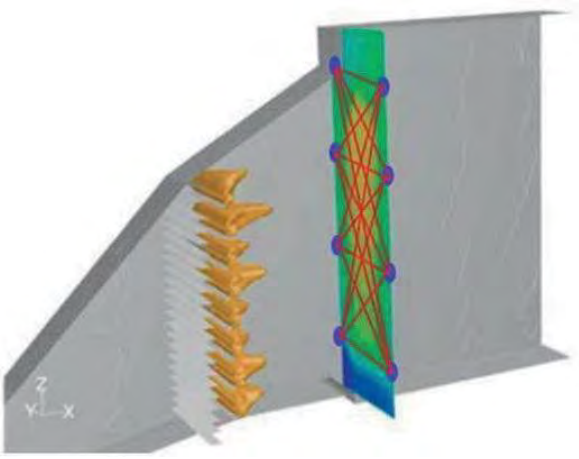


BOILERWATCH® MMP-II-SSX may be installed after the duct burner and before the HRSG. Advantages of this type of installation is the protection of the shock tubes in the HRSG and assurance of correct temperature for the NOx control. Thermal distribution is important for the obtainment of heat transfer in the different regions of the HRSG.

BBOILERWATCH® MMP-II-SSX display to the operators a thermal distribution in front of the superheater tubes thereby eliminating flame inpingement. Single path measurements can at the same time monitor temperature differences for timely NOx additives Injections. Amoniac slip will be reduced.



UNBALANCED

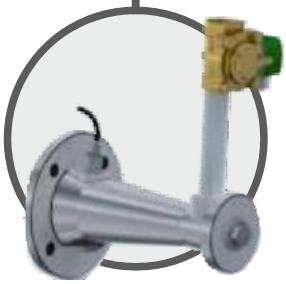


BALANCED

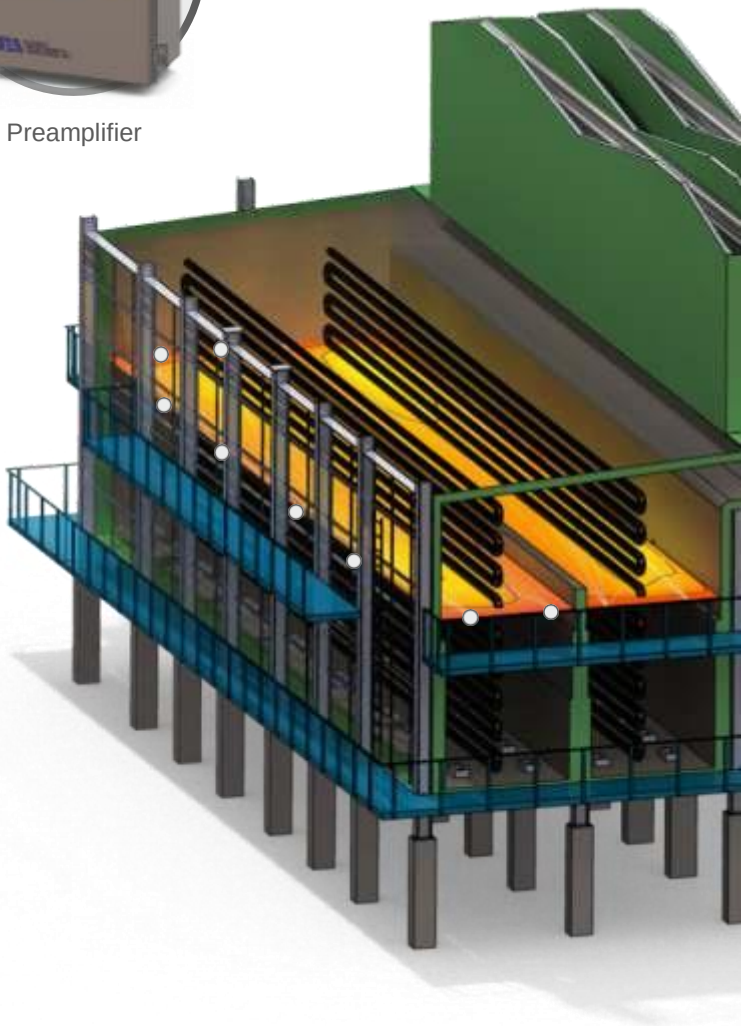
SINOPEC SHANGHAI DELAY COKER

Installation

Preamplifier



Wave Guide

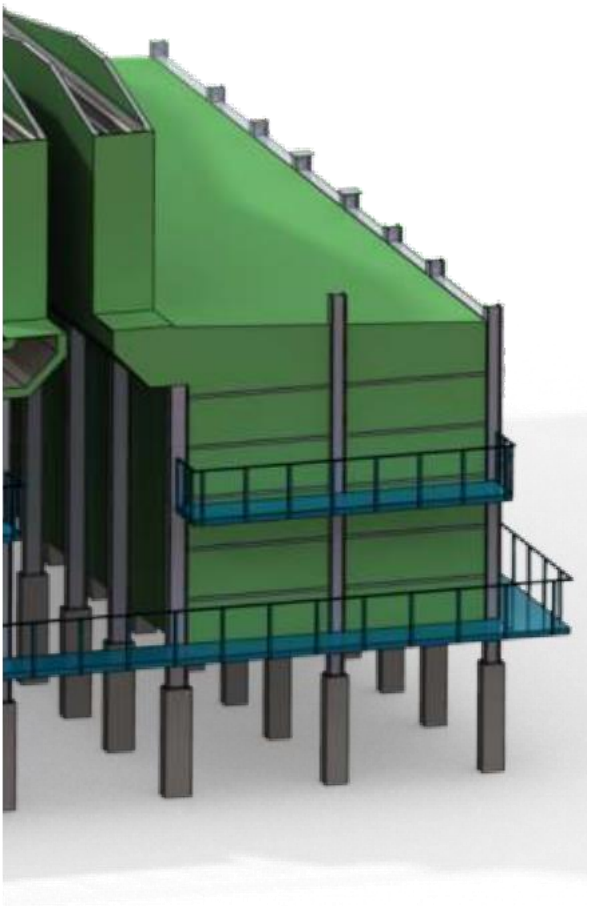


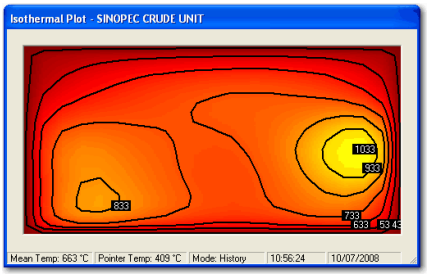
PCU

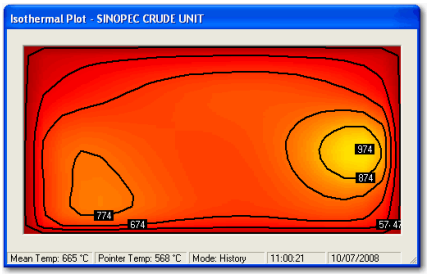
A uniform furnace temperature distribution is very important to avoid hot spots on the flame effect.

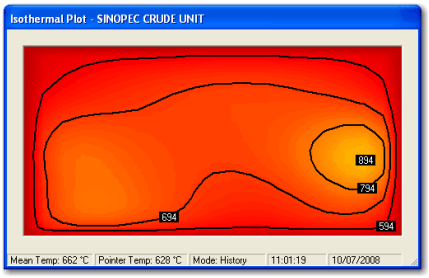
One of the problems encountered in refinery furnaces is the heat flow imbalance. This imbalance can cause high coker formation and high temperatures metal tubes that that reduce the unit ability and may cause premature failure.

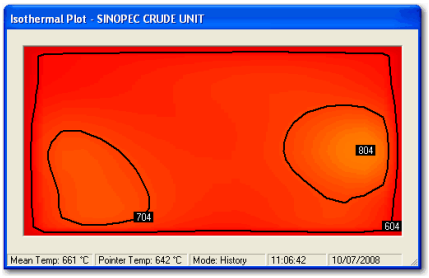
As you can see in the Acoustic Pyrometer Isothermal map there is a hot spot at the process tubes, which making adjustments to the air and fuel register was achieved a balance heat distribution by reducing the hot spot and maintaining the same temperature average household. The ΔT (temperature differential) before and after adjustments was reduced significantly. Before adjustment the ΔT between the Minimum and Maximum temperatures Areas was reduced from 200 °C to 40 ° C.

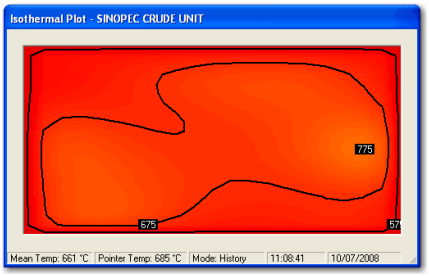


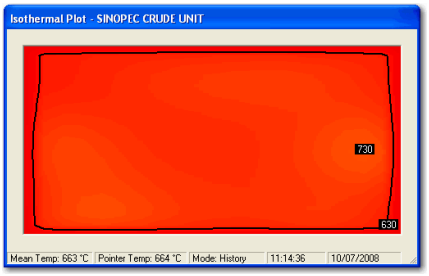


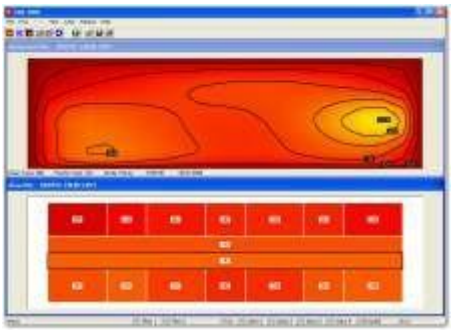












Max. Temp: 792ºC
Min. Temp: 585ºC
ΔT: 207ºC
Mean Temp: 666ºC

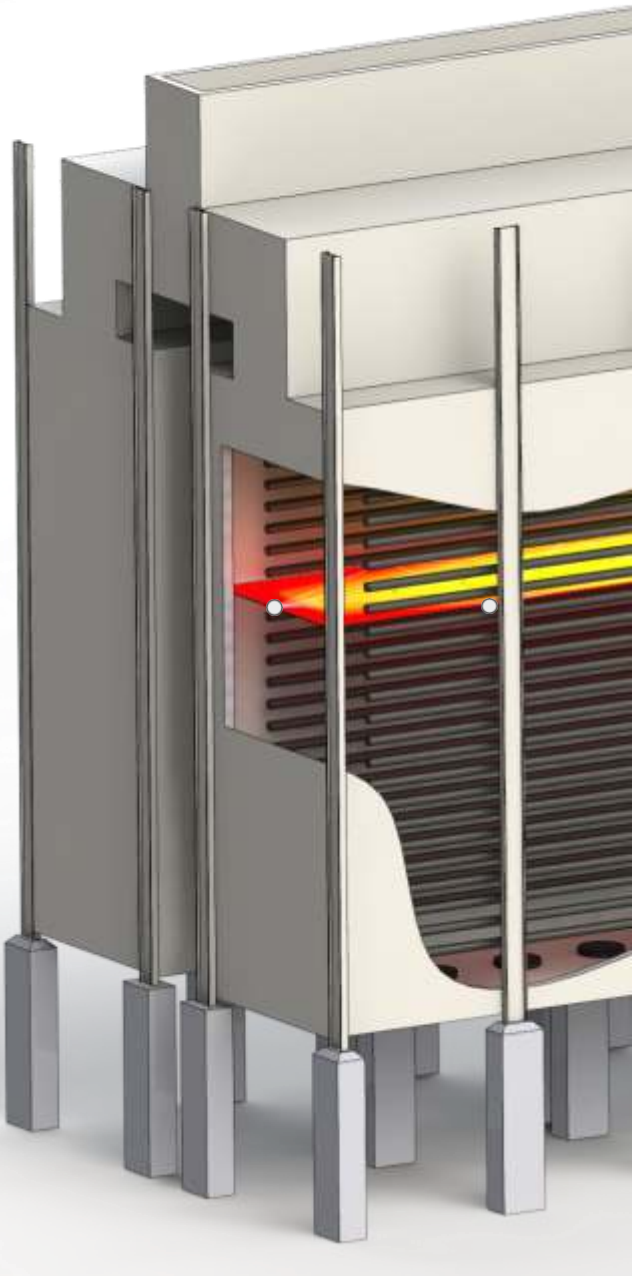
Max. Temp: 701ºC
Min. Temp: 664ºC
ΔT: 37ºC
Mean Temp: 666ºC

PETROBRAS REGAP DELAY COKER

Installation

Wave Guide

Preamplifier



PCU

The problem with the image 1 is that most of the heat is concentrated in the center of the heater. The heat needs to be evenly distributed along the entire heater in order to reduce coke build up in the process tubes. Air register adjustments are needed to achieve a more even heat distribution.

The image 2 shows a broader heat distribution in the center of the heater. This maximizes the efficiency of the heater by reducing the concentrated heat as seen before and even distributing it along the heater.

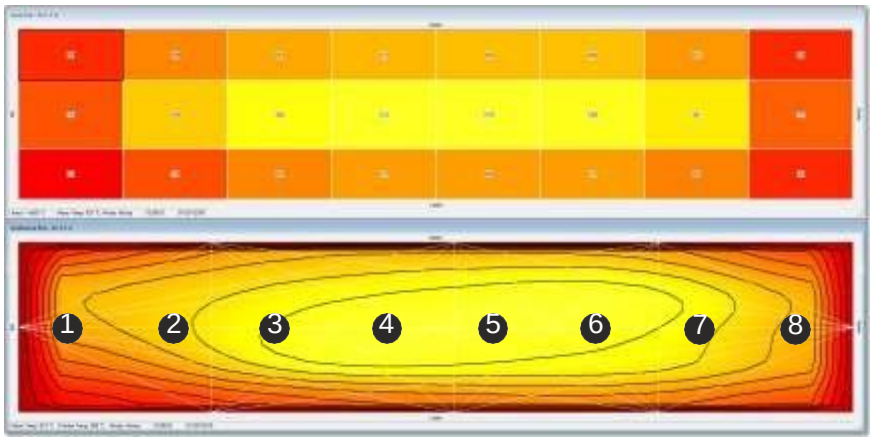


Image 1
Max Temp: 1015ºC
Min Temp: 634ºC
Mean Temp: 831ºC

BURNER#	PRESET	ADJ 1	ADJ 2	ADJ 3
1	45%	28%	20%	20%
2	35%	35%	25%	20%
3	30%	35%	30%	25%
4	30%	40%	35%	35%
5	30%	35%	35%	35%
6	40%	40%	40%	40%
7	25%	20%	20%	20%
8	40%	28%	20%	20%

The adjustments made to the air registers per burner

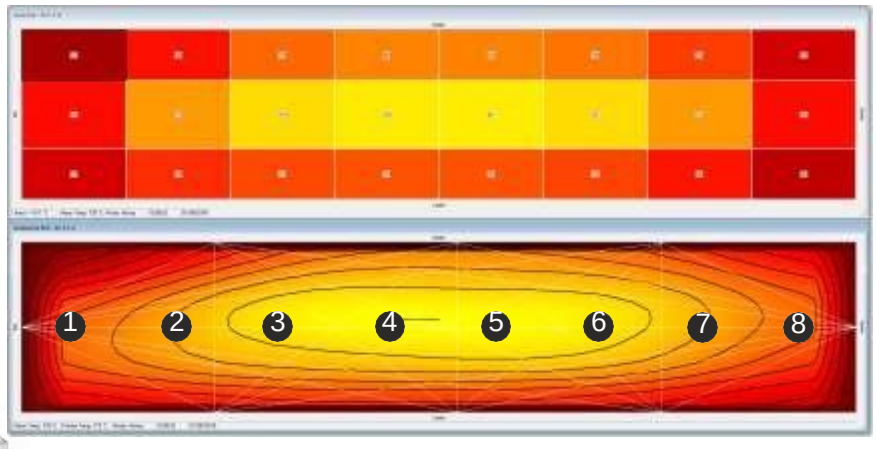
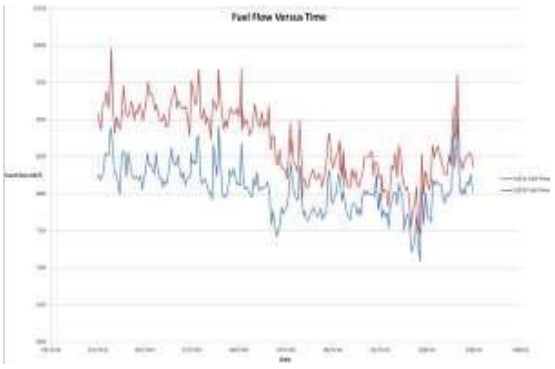


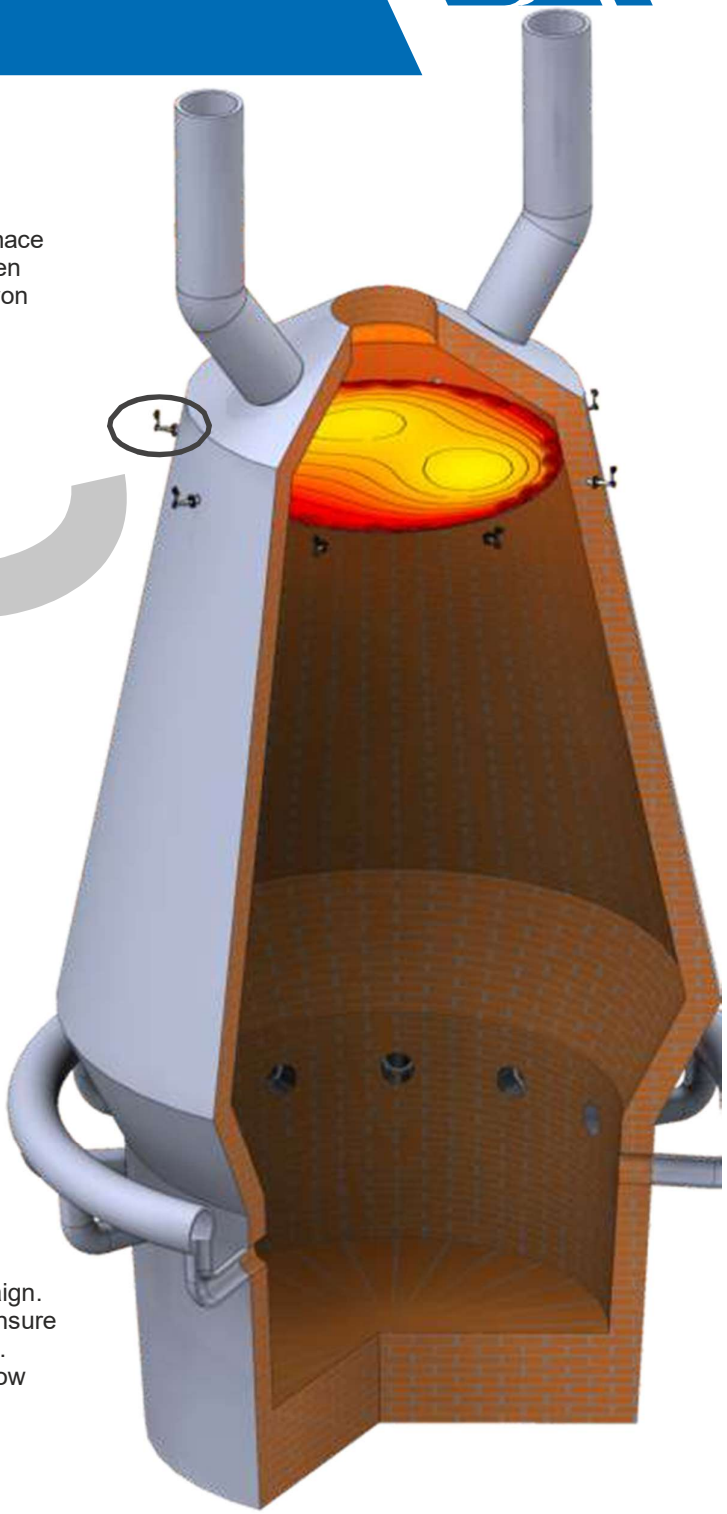
Image 2
Max Temp: 941ºC
Min Temp: 517ºC
Mean Temp: 735ºC

The graph below shows the fuel flow for both Cells A and B. Cell A had much lower fuel consumption since the previous adjustments. After the upset and change in the air registers, Cell A's consumption decreased to that of Cell B's levels. On average, before the upset the difference between Cell A's fuel consumption and Cell B's was 100 m3/h. This translates to a fuel savings of 2400 m3 of fuel saved by only adjusting one cell or a 12% decrease in fuel consumption.



Blast Furnace

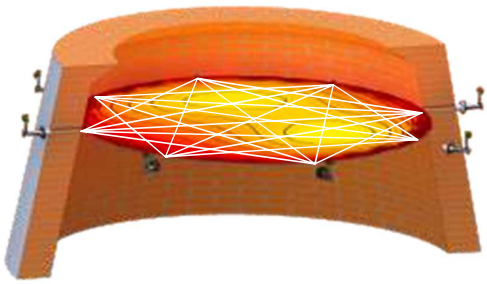
A high-temperature thermal reserve zone forms in a blast furnace portion where the burden temperature is 950 to 1,000ºC. When the temperature of the zone is equal to the W point (wustite-iron reduction equilibrium point) of the RIST diagram1), the shaft efficiency of a blast furnace becomes 100%.



BENEFITS

- Essential tool for process control
- Helps maximize fuel efficiency
- Significant contribution to extending furnace life by improved operating stability
- Identifies blast furnace charging problems
- Ensures uniformity of burden distribution across the furnace
- Operates automatically and remotely whilst on blast

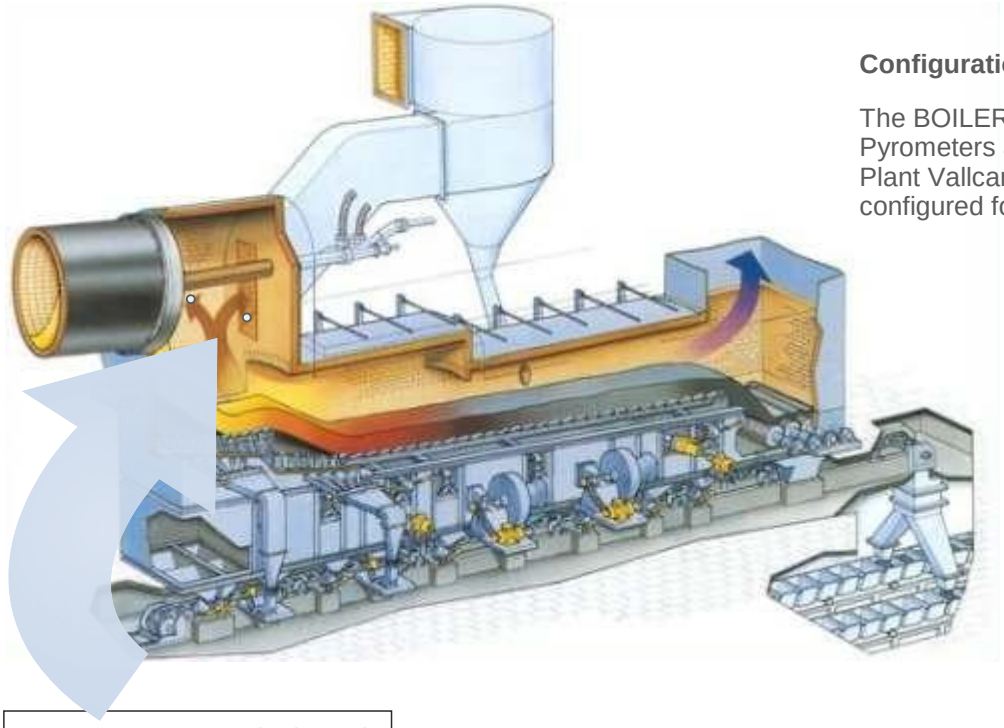
Well engineered equipment and refractories which minimize production downtime and maximize the blast furnace campaign. Advanced process control and automation systems which ensure stable process conditions with minimum operator interaction. Solutions which reduce emissions to the environment to below legal limits.



In general, the system consists of 8 identical sender/receiver (transceiver) units, an external control unit and an external evaluation unit. Nitrogen is used for sound generation. With 8 sensor obtain up to 20 paths.

Cement Applications

UNILAND Valcarca – Spain



2 ports 3020TR. 1 Single Path

Configuration of the Acoustic Pyrometers

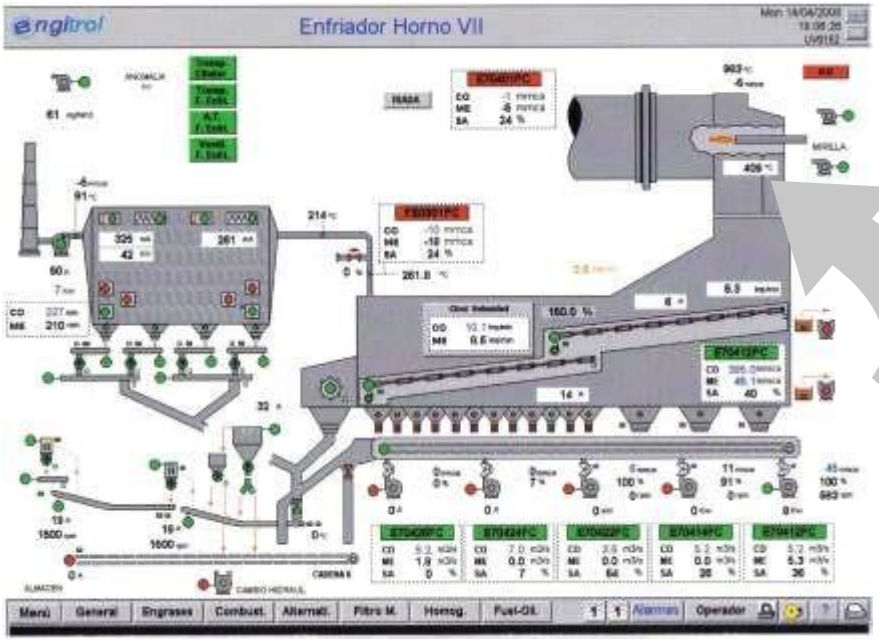
The BOILERWATCH® MMP II, Acoustic Pyrometers are installed in UNILAND Cement Plant Vallcarca – Sitges, Spain with 2 ports configured for 1 Single Path at the Cooler Kiln.

The BOILERWATCH MMP II Processor Control Unit (PCU) was mounted at a room not more than 150 meters.
The temperature information is supplied to the control room via analog output 4 - 20 mA

WAVEGUIDE

PREAMPLIFIER

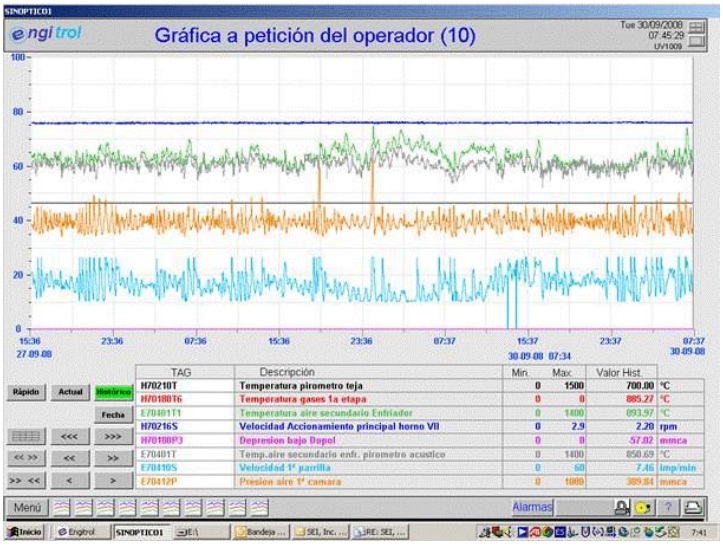
PCU



ANALOG 4-20 mA DATA OUTPUTS

The MMP II PCU includes 24 channels of 4-20 mA analog signal outputs for interfacing path temperature information to external devices such as DCS systems, control equipment, recorders, etc. One analog channel is available for each of the possible 24 path temperatures.

DATA at Control Room

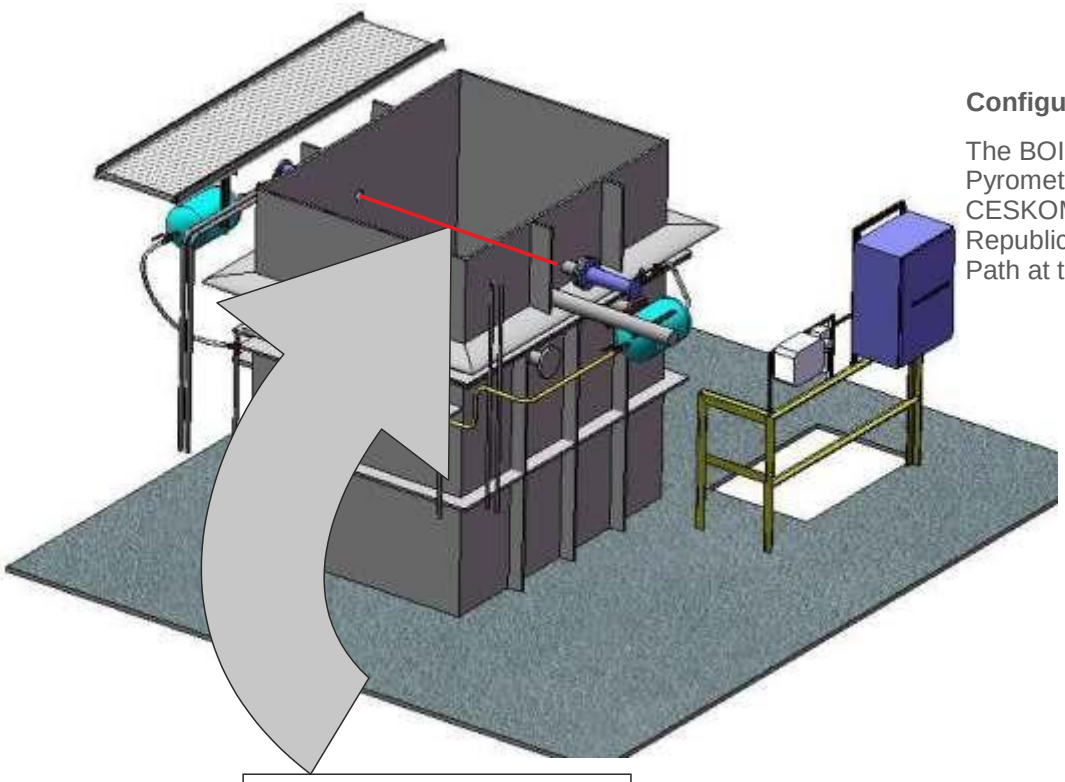


Thermocouple

Acoustic Pyrometer

This graph shows the sensitivity of the acoustic pyrometer. In the event mentioned, shows how the thermocouple is slower because the thermal inertia of materials in contrast the acoustic pyrometer measures the average temperature of the gas.

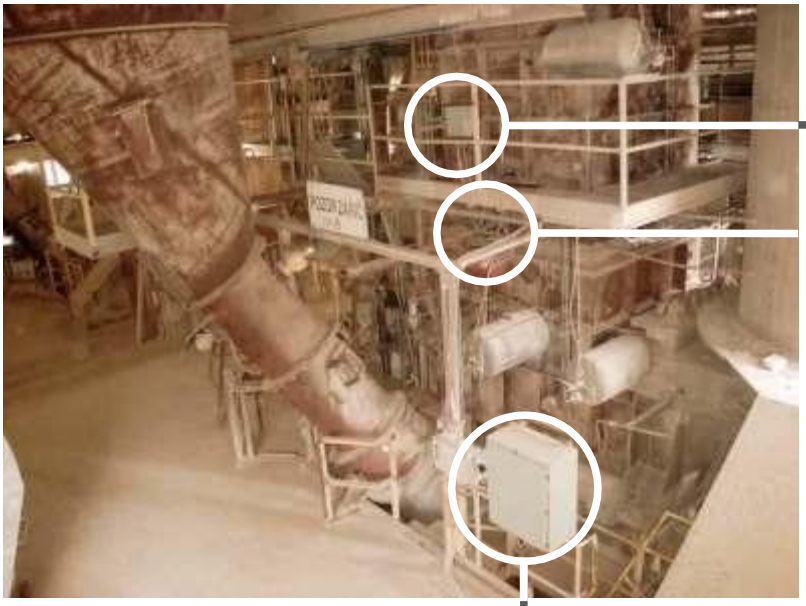
CESKOMORAVSKY Cement Czech Republic



2 ports 3020TR. 1 Single Path

Configuration of the Acoustic Pyrometers

The BOILERWATCH® MMP II, Acoustic Pyrometers are installed in CESKOMORAVSKY CEMENT Czech Republic with 2 ports configured for 1 Single Path at the Tower.



PREAMPLIFIER

WAVEGUIDE

PCU

The BOILERWATCH MMP II Processor Control Unit (PCU) was mounted not more than 150 meters. The temperature information is supplied to the control room via analog output 4 - 20 mA.

ANALOG 4-20 mA DATA OUTPUTS

The MMP II PCU includes 24 channels of 4-20 mA analog signal outputs for interfacing path temperature information to external devices such as DCS systems, control equipment, recorders, etc. One analog channel is available for each of the possible 24 path temperatures.

Analog signal outputs are 420 mA, and it were automatically scaled to the minimum and maximum temperature measurement range specified by the user during system setup. The value of each signal is updated at the completion of each measurement.