IGNEIS 400

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Automation and Energy Optimization

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Is is a modern control system, dedicated to total boiler automation and minimization of energy consumption, which is achieved through its special optimization functions

Energy and Efficiency:

$$\text{accummulated efficiency} = \frac{\text{total produced energy}}{\text{total consumed energy}}$$

$$= \frac{\text{total steam mass x (steam enthalpy - water enthalpy)}}{\text{total consumed fuel x heating value}}$$

$$= \frac{\sum m_v \times (h_v - h_a)}{\sum m_c \times H_c}$$

The system computes the real boiler efficiency, caculated as the quotient of the produced energy and the consumed energy.

Steam enthalpy is calculated as a function of the measured steam pressure, whereas water enthalpy is calculated from the measured water temperature. The steam mass is integrated from the measured steam mass flow.

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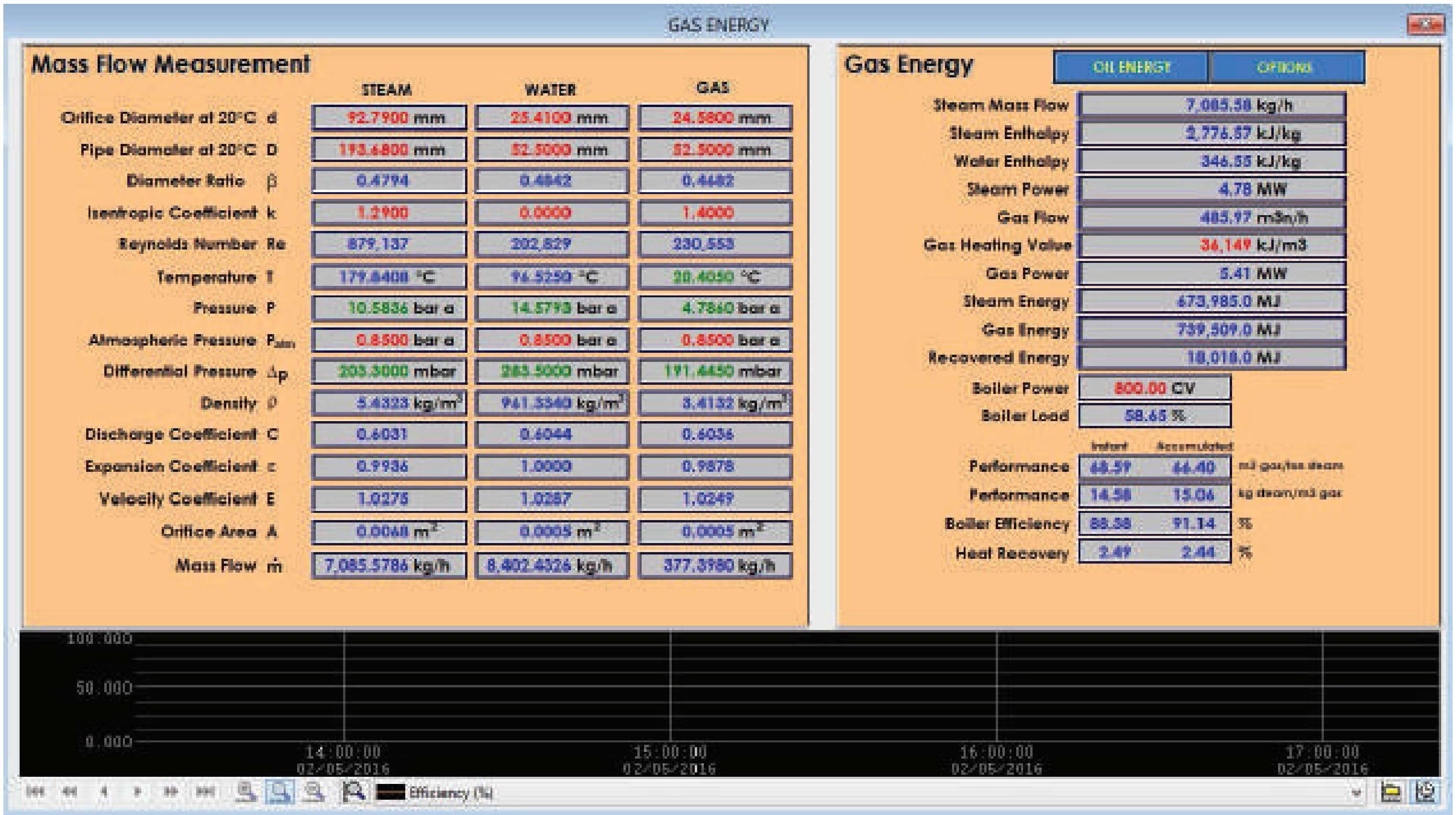
System screen for flow, energy and efficiency:



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Fuel oil mass flow measurement

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Steam mass flow measurement

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Volume flow meter arrangement for fuel gas

Combustion Optimization

- *An air-to-fuel characteristic is defined with up to 30 points, from low to high fire, for every kind of fuel (light oil, heavy oil, natural gas, LP, bio-fuels, etc.).*
- *Every point of the air-to-fuel characteristic is so determined as to find the value where the maximum efficiency is attained for that firing rate, as shown on the screen.*
- *The system memorizes the percentage of oxygen at stack, at wich the maximum efficiency was attained for every firing rate.*
- *Full characterizacion consists therefore of a set of 3 values for every firing rate: fuel valve position, air damper position, oxygen at stack.*
- *Henceforth, the system will adjust the air-to-fuel ratio automatically to maintain maximum efficiency at any firing rate, in spite of varying air and fuel conditions.*
- *Adjustment of the air-to-fuel ratio is possible by means of the air damper or of a variable speed drive at the fan.*
- *Increases in boiler efficiency have been registered in the order of 4...12%.*
- *Air-to-fuel characteristics are stored twofold in the system: in the controller´s flash memory and on the operator terminal´s hard disk; they can be recalled and reloaded at any moment*

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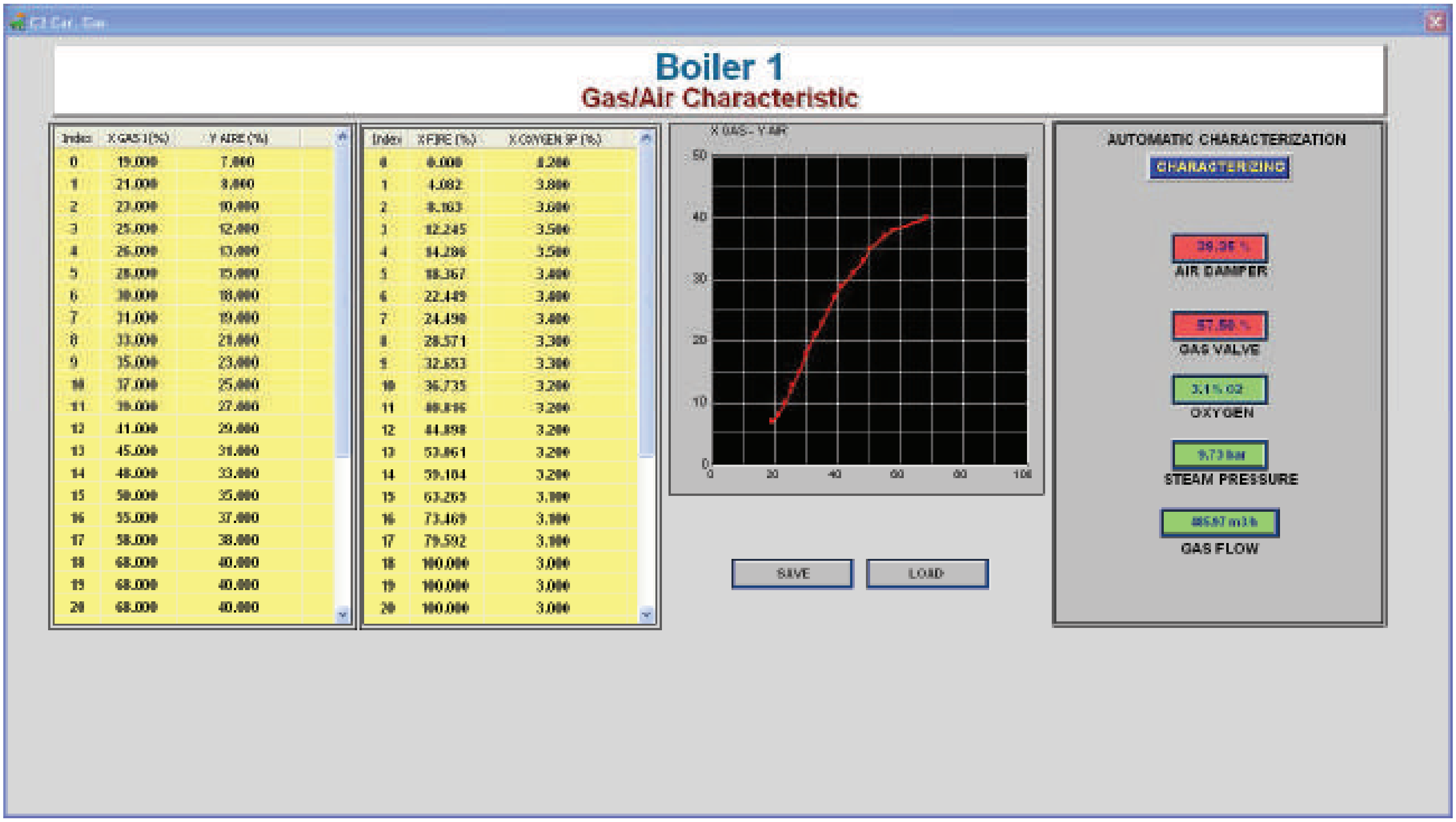
Boiler characterization screen



Index	X GAS 1 (%)	Y AIRE (%)
0	19.000	7.000
1	21.000	8.000
2	23.000	10.000
3	25.000	12.000
4	26.000	13.000
5	28.000	15.000
6	30.000	18.000
7	31.000	19.000
8	33.000	21.000
9	35.000	23.000
10	37.000	25.000
11	39.000	27.000
12	41.000	29.000
13	45.000	31.000
14	48.000	33.000
15	50.000	35.000
16	55.000	37.000
17	58.000	38.000
18	68.000	40.000
19	68.000	40.000
20	68.000	40.000

Index	X FIRE (%)	X OXYGEN SP (%)
0	0.000	8.200
1	4.082	3.800
2	8.163	3.600
3	12.245	3.500
4	14.286	3.500
5	18.367	3.400
6	22.449	3.400
7	24.490	3.400
8	28.571	3.300
9	32.653	3.300
10	36.735	3.200
11	40.816	3.200
12	44.898	3.200
13	53.061	3.200
14	59.184	3.200
15	63.265	3.100
16	73.469	3.100
17	79.592	3.100
18	100.000	3.000
19	100.000	3.000
20	100.000	3.000

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Air damper and fuel valve actuators on a dual fuel burner

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Variable speed drives for fan and water pump

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Oxygen measurement at stack

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Boiler Control Unit

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Level Control: can be switched between 1 element and 3 elements.

Level Control Valve

One Element Level Control: An archimedic level transmitter is used for level measurement; a PID controller modulates the water feed valve to keep level constant. This transmitter is unaffected by bubbles or corrosion.

Three Element Level Control: Besides the level transmitter, steam flow and water flow are taken into consideration. The system keeps both flows in balance; an increase in steam flow causes an increase in water flow; likewise, a decrease in steam flow causes a decrease in water flow. Level is thus maintened constant even at sudden demand spikes.

Archimedic level transmitter

Surface Blowdown (Salts)

Surface blowdown valve

Salt concentration is determined through continuous measurement of water conductivity. A PID controller commands the surface blowdown valve by means of width modulated pulses; longer pulses are sent to the valve at deviation from setpoint; short pulses are applied when near to the setpoint. Salts concentration is thus kept at constant value.

Conductivity setpoint is determined through water analysis at the laboratory and set by the user.

Conductivity sensor and transmitter

Sludge Blowdown

Several blowdown valves can be operated sequentially in the case of large boilers.

Sludge blowdown is accomplished by the system at programmable intervals. Length of the intervals and duration of the blowdown are adjusted by the user, in accordance with water analysis.

The blowdown valve is a globe type one, for high differential pressure and tight closing. A limit switch confirms the opening of the valve; failure to open at the programmed intervals causes an alarm.The valve can also be operated manually.

Chemicals Feed

Low level at the dosing tank causes an alarm.

Chemicals for inhibition of corrosion and binding of oxygen are fed into the boiler and to the deaereator in proportion to the measured water flow. In this way, a higher water feed flow causes a larger dosage of chemicals, a smaller water flow reduces the dosage. This results in dosing only the needed amount, saving chemicals.

The correct dose for each chemical is determined by laboratory analysis and set by the user. A separate dosing pump is used for each chemical and controlled with an analog signal.

Water Pump Control

Controlling the water feed pressure to the boiler assures a very even level control. A pressure transmitter is installed in the water feed header and the pump speed is modulated by means of a variable epeed drive, thus keeping pressure constant with a PID algorithm.

In case of boiler systems with several pumps, these are staged automatically, following header pressure.

Failure of one pump causes the next pump to start automatically. Pump sequence is rotated periodically by the system; periods are determined by the user.

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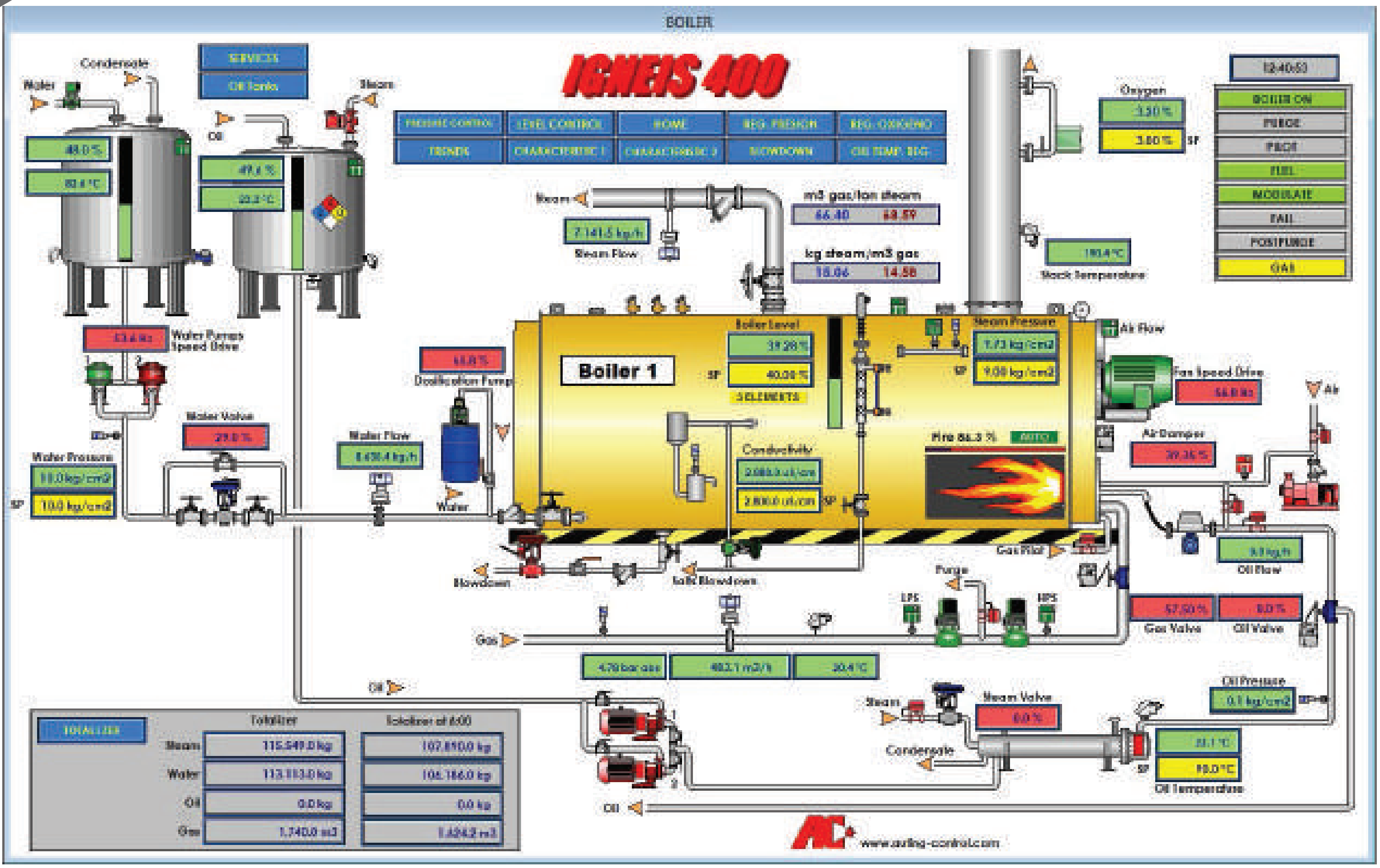
Operator Terminal



A wide screen monitor is built in the control cabinet , allowing the user to operate the boiler locally. Many operator screens are available, enabling monitoring and operating functions, i.e.:

- *General boiler overview screen*
- *Controls tuning screens (for pressure, combustion, level, blowdown, etc.)*
- *Energy and efficiency monitoring screen*
- *Trends screen (pressure, level, steam flow, water flow, stack oxygen, fuel flow, efficiency, etc.)*
- *Data logs (all measured and calculated values)*
- *Alarms screen and log (of all possible alarms)*
- *Para meter and configuration screen*

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