WHITE PAPER

EX-Proof Furnace Camera with Video Thermography Application: Refinery Utilities Power Plant

Project:
HHP Boiler Pertamina RU V – Balikpapan
East Borneo, Indonesia

INTRODUCTION

Many Industrial combustion users face demanding situations to achieve efficiency of maximum electricity production and to measure effectiveness of gas management. These industrial users need to make certain the heat inside the boiler is sufficient for required output and balanced in distribution to avoid damage in the boiler. In some instances, whilst the manufacturing is on shutdown for inspection, some users inspect and locate damage and ruptures on the boiler tubes with no training for changing the cause, subsequently it results in more time for shutdown and greater losses in time for production.

One such industrial user is a refinery utilities power plant. Pertamina is an Indonesian state-owned oil and natural fuel corporation. Currently, Pertamina owns six oil refineries which have a total combined potential of round 1 million barrels (160 thousand cubic meters) of oil per day. Pertamina RU (Refinery Unit) V is located in Balikpapan, East Borneo-Indonesia, has a crude oil processing capability of 260 MBSD, equivalent to 25% of the countrywide intake ability and a country wide marketplace percentage of 15.6% fuel oil. Pertamina RU V utility facilities are Steam Turbine Generator, Cooling Water Intake, Sea Water Desalination, Water Treatment Plant, and HHP Boiler.

Pertamina RU V has 6 units HHP Boiler with steam capacity of 420ton/hr. In order to make optimal performance from HHP Boiler, Pertamina RU V set up a requirement to install a furnace camera for all HHP Boiler chambers. Their required purposes from the furnace camera is to reveal the flame pattern (imaging) and intensity (thermograph) in respect of Boiler burners, screen boiler tubes and temperature distribution within the furnace.

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Their requirement was for:

- Appropriate for Hazardous Area with classification ATEx zone2 or Class 1 div 2

- Suitable for the furnace layout as with dual fuel (natural gas & heavy oil)

- Withstanding the furnace temperature of up to 1600°C

- Designed with 60-80% of discipline view lens (flame pattern) at every length

- Commensurate with the furnace size, the location and the positioning of the burners.

And with those requirement, DURAG Furnace Sensor D-FS 50 with Video Thermography Analysis D-VTA 200 is the right answer for Pertamina RU V HHP Boiler.

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FURNACE CAMERA WITH VIDEO THERMOGRAPHY ANALYSIS

DURAG have two types of Furnace Sensors:

1. D-FS 2

    Furnace Sensor D-FS 2 delivers high definition live images directly out of the combustion chamber with video resolution of 1280x960. D-FS 2 is designed with a pneumatic retraction for a safe zone area. D-FS 2 has both water- and air-cooling system to protect the sensor inside the burner when inserted. Water cooling system could hold up to 2000C and air-cooling system could hold up to 1600C inside the boiler. D-FS 2 system will be connected to the Control Cabinet, in the Control Cabinet, users can see alarm lamp for low pressure and fault for high temperature, also buttons such as reset, test, retract and insert lance. From Control Cabinet connected via Fibre Optic, the video can be showed by a video system for visual only (D-VT 50) or to a video analysis with thermography software (D-VTA 200).

2. D-FS 50

    Digital Furnace Sensor D-FS 50 delivers brilliant live video directly out of the combustion chamber with video resolution of 1280x960. D-FS 50 is design for fix installation (without retraction)and there is also a version especially for Hazardous Areas. D-FS 50 also has both water- and air-cooling system to protect the sensor inside the burner when inserted. Water cooling system could hold up to 2000C and air-cooling system could hold up to 1600C inside the boiler. Unlike D-FS 2, D-FS 50 will be connected to a simple control cabinet without any control buttons. Via Fibre Optic, the video can also be showed by a video system for visual only (D-VT 50) or to a video analysis with thermography software (D-VTA 200).

    To support the function of the video sensor DURAG have two media system:

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1. D-VTA 200

   A software thermography for temperature analysis. The software calculates the temperature from the intensity of the radiation of each pixel and generates a color coded (thermal) image from the live-video image. Thus the thermal image obtained corresponds to the current temperature profile of the observed scene inside the combustion chamber. With the software, customer will get a historical trend display, video and data recording, Line of Interest (LOI) and Region of Interest (ROI) if point/section temperature that are needed. D-VTA 200 also has other features on temperatures analysis such as Flame Front, Flame Profile, Fire Ball, Ignition points, and other customer specific customize solution from the video thermography. D-VTA 200 comes with 19" industrial PC incl. 24" TFT monitor, industrial mainboard with min. i5, 8GB RAM, RAID1, operating system: Linux, thermography software, live image and recording to HDD, remote control of the furnace sensor, alarm display, power supply: 110/230VAC, 50-60Hz.
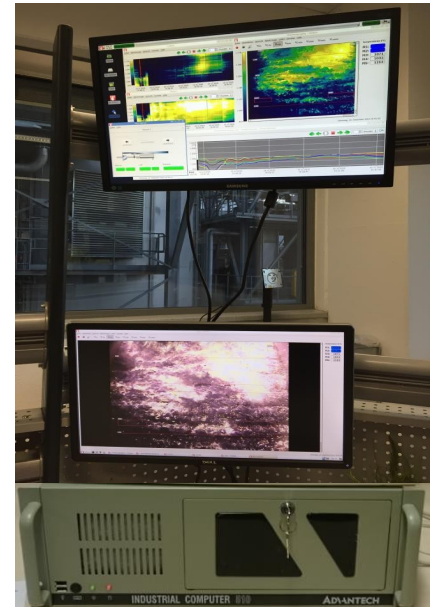
2. D-VT 50

   A video viewer to be connected to one furnace sensor and display the video with HDMI/VGA cable from a input of GigE vision. D-VT 50 comes with a micro PC fanless with 1 x GigE, RJ45, 4 x USB for Mouse + keyboard. Operating system of D-VT 50 is Linux, include with the feature of shutter control and display D-FS 50 tip temperature.
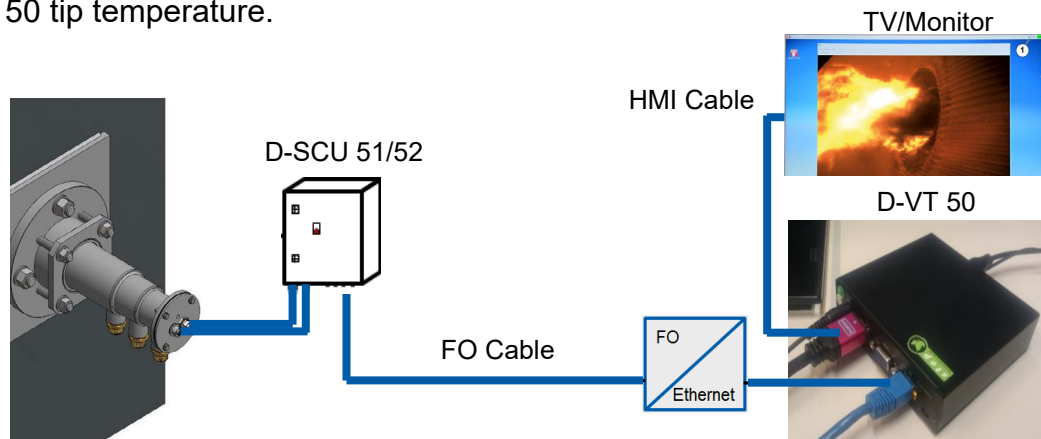
For Pertamina RU-V HHP Boiler, DURAG comes with an explosion proof design of furnace sensor D-FS 50 and control cabinet, according to the hazardous zone of ATEX Zone 2 area. The furnace sensor D-FS 50 and control cabinet D-SCU 51/52 are completed with a different design and with additional accessories to support the EX-version of the system.
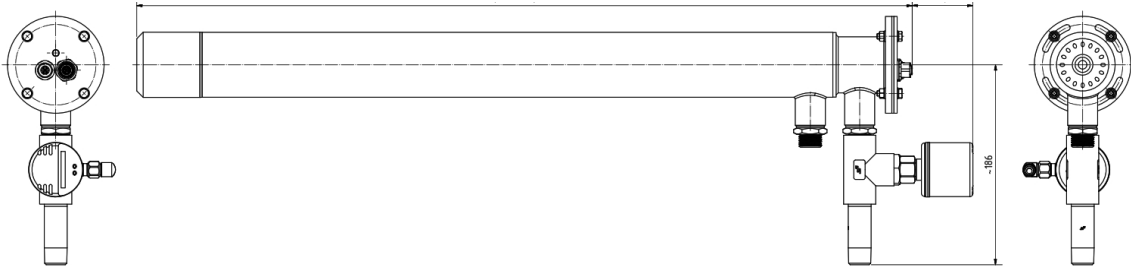
1. Flow switch for cooling system.
    Additional accessories for this application is a flow switch installed in a cooling air system inlet. Ex-protection: II 3G Ex pzc IIC T4 Gc
2. Control Cabinet (D-SCU 51/52) design and material
    D-SCU 51/52 designed with enclosure of GUB05 to be compliance to Ex-protection: Ex-protection: II 2GD Ex d IIC T5 Gb Ex tb IIIC T100°C Db.
3. Flow switch connection cable
    Additional input on the D-SCU 51/52 for Flow. If the flow on the cooling system is lower that it's set on the Flow then the sensor will be shutdown automatically, and the displayed of the shutdown will be shown on the D-VTA 200. Messages of loss connection of the sensor will also be shown on the D-VTA 200 display. This to avoid the sensor from the heat inside the chamber from insufficient air system and protection of the sensor.

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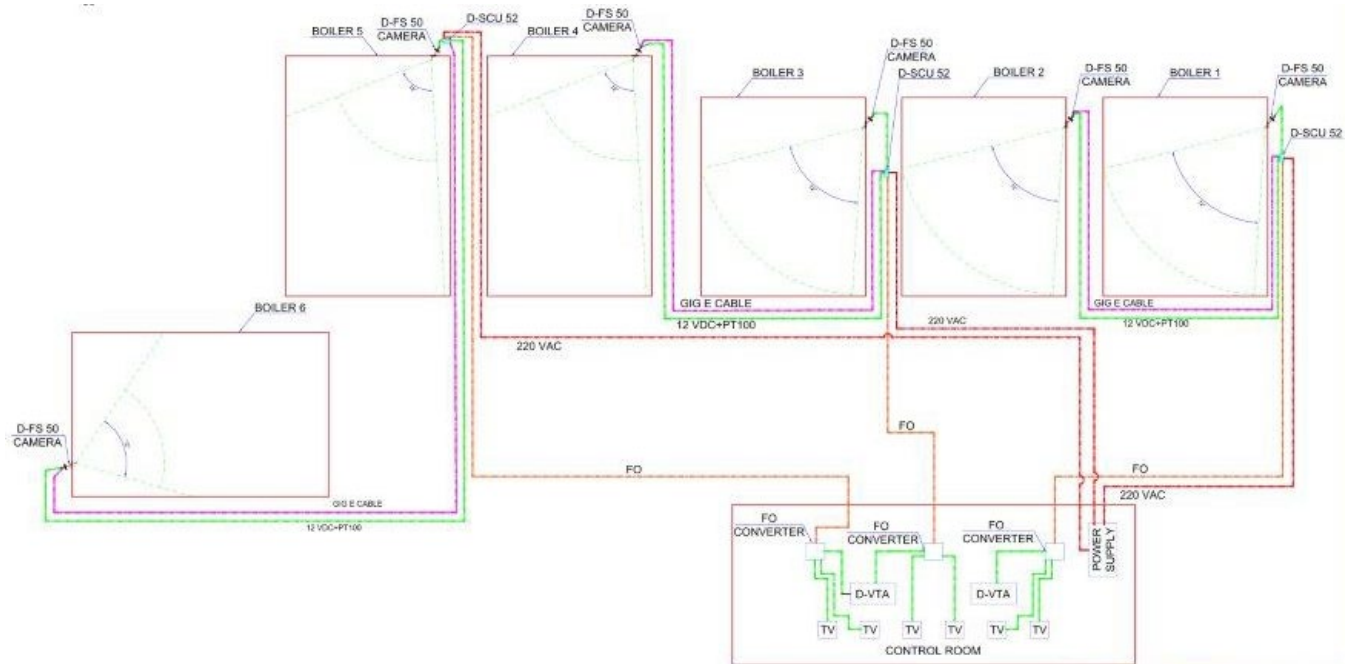
Pertamina RU-V HHP Boiler have 6 Boiler with unit 1,2 and 3 are identical, 4 and 5 are also identical of each other, and unit 6 has a different design. Each 3 type boiler has a different burner and viewing point position for the sensor installation. HHP unit 1, 2 and 3 have 4 burners and 4, 5 and 6 has 2 burners in vertical position. Recently PIN has installed 2 of 6 boilers in HHP boiler unit 1 and 5 with above system overview.

D-FS 50 installed in each boiler, the Control Cabinet (D-SCU 52) is designed to connect 2 sensor input and one output FO to the D-VTA 200. D-SCU 52 is placed on HHP Boiler unit 1, 3, and 5, sensor connection unit 2 will be connected in D-SCU unit 1, sensor connection unit 4 will be connected in D-SCU unit 3, and sensor connection unit 6 will be connected in D-SCU unit 5. From D-FS 50, connection cable include with GigE cable, 12VDC, PT100, and Flow switch cable to the Control Cabinet. From Moxa on the control cabinet, data converted to FO Cable. On Control Room, FO connected to patch cord, from Patch cord then connected to FO Converter to Lan. Lan cable will be connected to the D-VTA 200. From D-VTA 200 HDMI and VGA output, the video is displayed to 2 TV for each D-VTA 200. In total, this project has 3 system of D-VTA 200 to displayed 6 sensor video. FO cable from the D-SCU 52 to Control Room could go up to 500m.

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THE RESULT

Before – HHP Boiler Unit 5
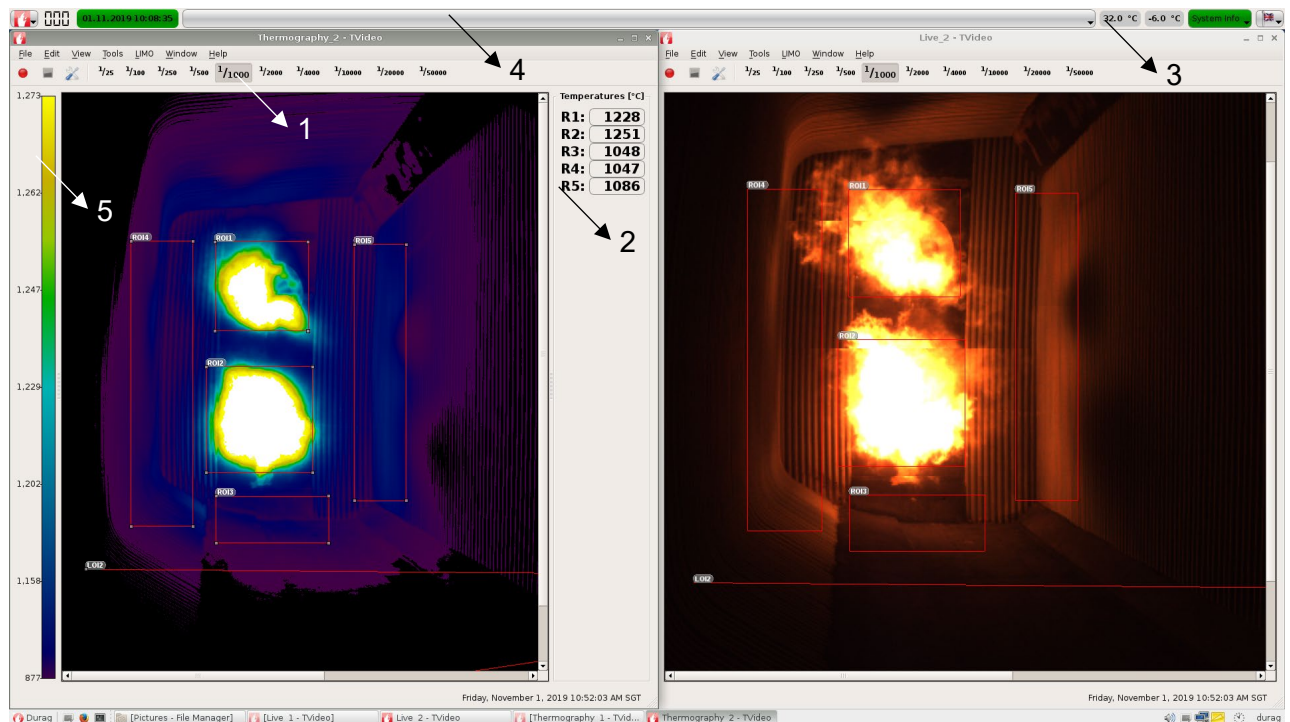
The picture above taken at 10.52AM, shows an uneven distribution of flame on burner the top. On the left picture, is the display of live thermography analysis and the right picture is the live video from the burner chamber. The colors of bar on left side (5) is showing the minimum and maximum of temperature inside according to its color. The display shows Region of Interest (2) are on the walls of the burner chamber and on the flame itself. From here, customer can see the pattern of the flame and the Flame profile inside the chamber. On the task bar on top, there's a message alert (4) to show information such as lost connection which leads to the low flow at the cooling system or the connection from Fibre Optic/D-SCU. Temperature of the sensor is also show on the right top of the display (3), if the temperature is above than the usual temperature of normal pressure of air instrument for cooling system, then it will show that the flow of air instrument for cooling system is low and the sensor needed to be checked on site. The same as others video sensor, the D-VTA 200 also has shutter speed of the sensor (1), the light-sensitive electronic in the DURAG sensor is exposed to the scene can be changed. This is called the exposure time. Having the right exposure time is also important, since it also controls the temperature measuring range. It will also show color focus on the flame that are wanted from the customer.

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After – HHP Boiler Unit 5
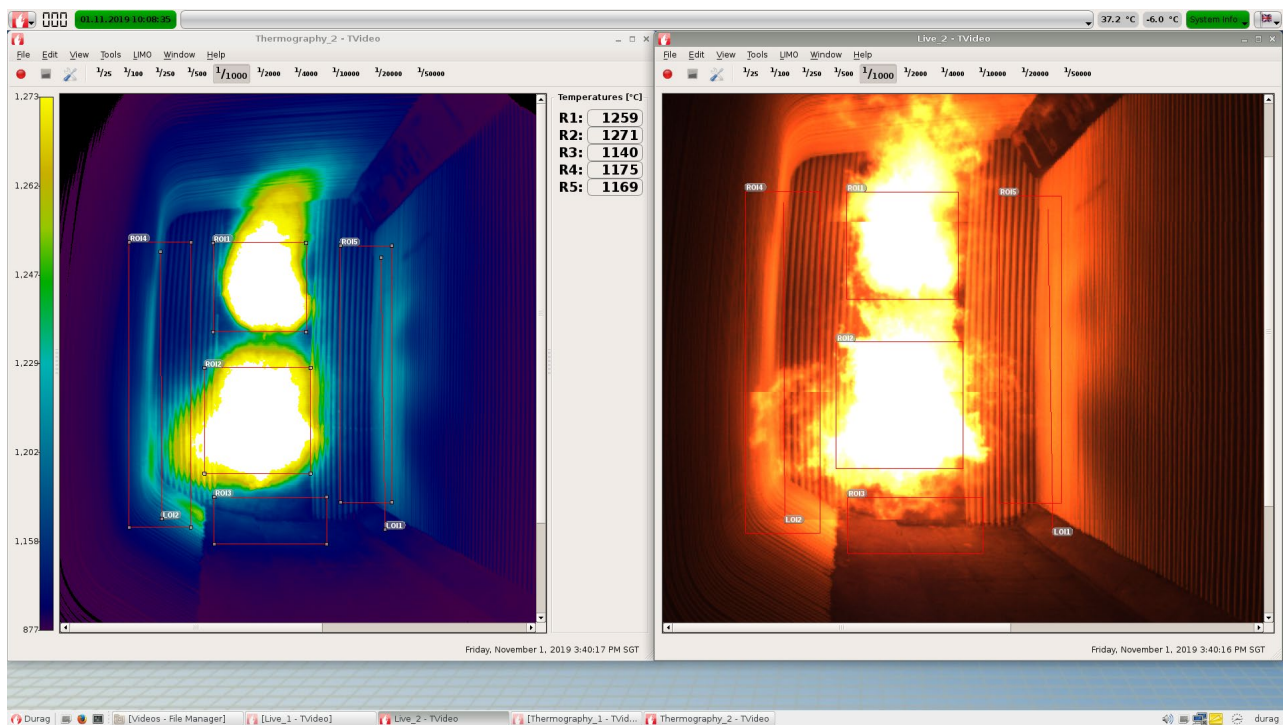
This picture taken at 3.40PM, the customer has done some adjustment on the fuel and air to control for the flame distribution. The difference has been made from the first picture to the second picture. Top burner has more even distribution of the flame, but the flame of both burners is still in different pattern. From the Region of Interest, the temperature increased up to 100degC in R3, R4, and R5. Which mean the volume of the temperature is higher than before. From the display, the customer has found that the bottom burner showing pattern of flame almost near to the wall, and the top burner also showing pattern of flame that almost near the upper wall of burner chamber. Both volume of each flame is also different, bottom burner has bigger volume than top burner. Unfortunately, the customer doesn't request of trending feature hence it is not shown on the display. But the customer has seen enough to fulfill their goals to analyze the flame pattern, temperature distribution, and the wall condition inside the burner chamber.

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THE SUMMARY

D-FS 50 with D-VTA 200 offers to the customer the ability to analyze flame burner inside the burner chamber continuously live, reliably and accurately in this application. DURAG Furnace Sensor system complies with the hazardous area application and can even give protection of the sensor from the flow switch.

Within weeks of installation the customer has realized fuel savings and optimized operation of the burners to increase boiler output, stabilize and align flame formation which in turn should realize a reduction in required maintenance.

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