

## PROCEEDINGS

JOINT CONVENTION BANDUNG (JCB) 2021

November 23<sup>rd</sup> – 25<sup>th</sup> 2021

### Eliminated Shutdown Thermal Oxidizer (TOx) by Manipulated Wave Signal of Flame Scanner with UV-IR Wave

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#### Abstract

CPP Gundih is one of the Central Processing Plant which operated in Pertamina EP Asset 4 – Field Cepu. One of the facilities in CPP Gundih is Thermal Oxidizer (TOx) which used for processing / combusting acid gas which generated from sweetening gas process to reduce air pollution in many chemical plants that decomposes hazardous gas at a high temperature. For operate TOx, there are some Instrument equipments supported to control, measure and protect during operation.

Previously, TOx in CPP Gundih used Flame Scanner with UV (Ultra Violet) Type to monitor firing operation inside TOx. Output data from Flame Scanner was used to control from PLC. PLC is hardware which have function to control and generate some data by using cause & effect matrix. Unfortunately, during 7 years operation, Flame Scanner which installed at TOx CPP Gundih always override because the signal strength from Flame Scanner was too low (less than 50%) and could not detect actual firing condition inside TOx and this issue was so dangerous because flame scanner triggered cause & effect for shut down system. If the operation didn't do override, TOx will shut down and probably loss production because of this case.

By that case, Maintenance teams tried to solved the problem by manipulating wavelength range of Flame Scanner, concern range of radiation. We replaced existing flame scanner from UV Type became UV – IR (Infa Red), which combination of UV and IR wavelength can cover wider radiation spectrum. All known electromagnetic radiations are customarily arranged monotonically according to their energy in a continuum called the *electromagnetic spectrum*. The electromagnetic spectrum spans many orders of magnitude in energy and, correspondingly, in frequency and wavelength. The optical radiation range is located between microwave radiation and X-rays. The optical radiation range is composed, in order of increasing energy, of infrared, visible, and ultraviolet radiation. Fortunately, after replaced flame scanner by using UV-IR Type, the signal strength was high, above 80% and operation don't do override again.

#### Introduction

CPP Gundih have some sequence process to generated natural gas become raw gas for selling to buyer. One of important sequence is Thermal Oxidizer (TOx) which which used for processing / combusting acid gas which generated from sweetening gas process to reduce air pollution in many chemical plants that decomposes hazardous gas at a high temperature.

TOx equipped which some instrument equipment, especially for measurement and controlling the process. Process control method at TOx used Programmable Logic Controller (PLC) which operated or controlled by using cause & effect diagram, beside used cause & effect, PLC at TOx used Burner Management System (BMS) to control burning sequence inside TOx.

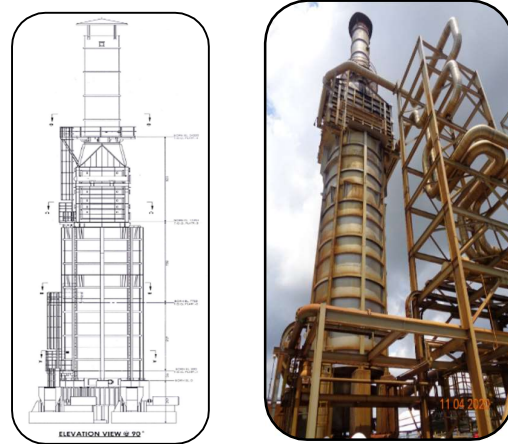


Figure 1. Drawing & Site Condition of Thermal Oxidizer at CPP Gundih

At TOx, there are some sequence process. One of them is burning process, which firing process from acid gas to eliminated Hydrogen Sulfide content and heat transfer for Waste Heat Recovery Unit (WHRU). During firing process, there are three Flame Scanners used for detection flame condition inside TOx.

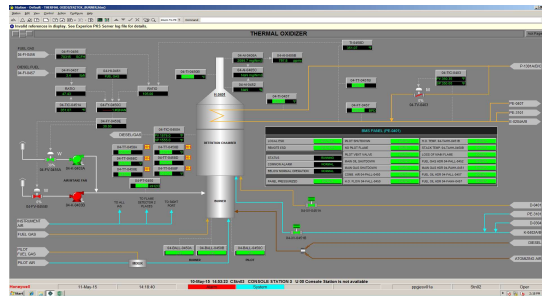


Figure 2. HMI from DCS for Thermal Oxidizer

Unfortunately, previous flame scanner used Ultra Violet (UV) type and cause the logic at PLC should be Override. The cause override was about signal strength from Flame Scanner was too low (less than 20%) and minimum requirement for normal operation should be above 20% to avoid un-planned shutdown. That's why the operation team should override to eliminated un-planned shutdown.

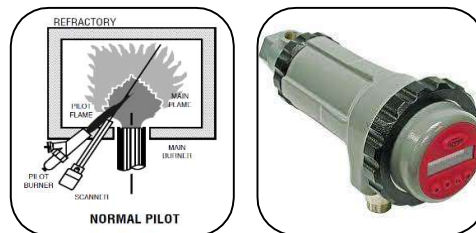


Figure 3 Flame Scanner philosophy and unit type

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### Data and Method

#### Basic Theory

When acid gas firing inside TOx, gas flame appearance was unpredictable because depend on gas composition. It could be blue flame color or orange color or yellow color. Flame color meaning can be indicative of temperature, type of fuel or the completeness of combustion. For example, a blue flame is the hottest followed by a yellow flame, then orange and red flames. Hydrocarbon gases burn blue whilst wood, coal or candles burn yellow, orange or red. A blue gas flame color is also indicative of complete combustion.

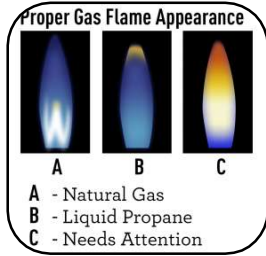


Figure 4 Flame Appearance

Furthermore, type of flame scanner existing used Ultra Violet (UV) Type which have short wave length. The length only from 10 nm – 400 nm . Based on that, the color of firing can not detect by flame scanner and impacted to low signal strength.

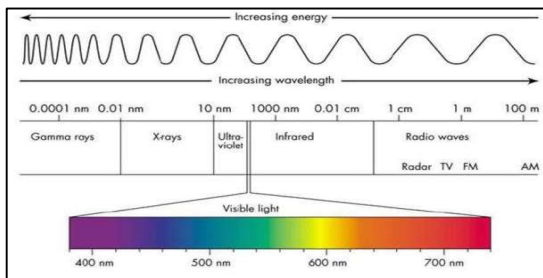


Figure 5 Diagram of Wavelength Flame

#### Execution

According that condition, Instrument Maintenance team purposed to manipulated flame firing condition by added Infra Red wavelength. We purposed to changed the existing flame scanner, from UV Type become UV-IR Type.

These activities started from collecting existing data from Distributed Control System (DCS) , basic theory about firing inside TOx and gas composition and equipment technical specification. After all fundamental theory already completed, Instrument Team purposed for Management of Change (MOC) to management for final decision about this planning. Continue to purchased material and inspected material before installation.

New Flame Scanner should be tested before install or swab from existing and these activities execute during off line condition to eliminate unstable condition.



Figure 6 Execution Process at TOx

#### Result and Discussion

After replacement process from UV Sensor to UV-IR Sensor at TOx and did commissioning. The signal strength, can be over 90% because the wavelength from flame scanner can detect flame color.

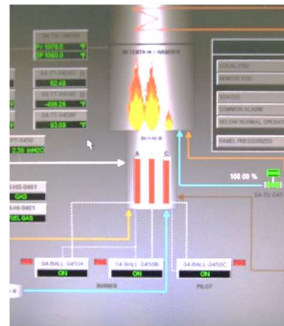


Figure 7 Recent HMI Condition especially about Flame Scanner Strength

By that condition, CPP Gundih can eliminated some high risk potential issue, among others :

- a. Eliminated Loss Production Opportunities Gas around 42 MMSCFD  
This potential issue will happen if the Flame Scanner (with UV Type) did not override and will impact TOx will shut down. If TOx shutdown, it means the sales gas will stop to buyer.  
Pertamina EP will loss Rp 4.800.000.000 per day
- b. Eliminated Loss Production Opportunities Condensate around 480 BOPD  
This potential issue will happen if the Flame Scanner (with UV Type) did not override and will impact TOx will shut down. If TOx shutdown, it means the processing gas will stop and separated condensate can not process
- c. Eliminated Additional Solar Fuel for Turbine Generator Operation  
This potential issue will happen if CPP Gundih shutdown because of TOx and raw gas for Turbine Generator will changed to Solar Fuel
- d. Safety issue about Override. Cause override one of the dangerous issue if gas processing still operated

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### **Conclusions**

By manipulated wavelength of Flame Scanner at TOx, we can rise up reliability of TOx without override issue and keep the process can run stable and safe.

### **References**

- (1) <https://en.wikipedia.org/wiki/Ultraviolet>
- (2) Fireye Flame Scanners, Supersedes February 17, 2015
- (3) <https://openstax.org/books/college-physics/pages/1-introduction-to-science-and-the-realm-of-physics-physical-quantities-and-units>

### **Acknowledgements (Optional)**

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