

# EZ-Flame Detection Unit

## Case Study

### Background

Project Name: Rabigh Power Plant, Saudi Arabia, 2x660MW Oil Fired Units

Contractor: SEPCO III Electric Power Construction Corp.

Boiler: Dongfang Boiler Group Co., Ltd.

### Situation

The Rabigh power plant project in Saudi Arabia consisted of 2 x 660MW subcritical oil powered boilers. They were front & rear fired boilers manufactured by Dongfang Boiler Group Co., Ltd. Both the front and rear walls are lined with four rows of burners respectively. Each row consisted of six swirl burners. The swirl burner ignited in two stages: first, the light oil igniter was placed into service. Then, the main burner running on heavy oil was started. The rated output for each main burner is 3210KG / hr, using steam atomization.

Each boiler utilized ninety-six (96) infrared flame scanners. Forty-eight (48) sets were used to monitor igniter flames, and the other forty-eight (48) were used to monitor main burner flames. The existing flame detectors installed at the Rabigh Power plant were having difficulties confirming their target flame status. When the boiler operated at high load conditions, the flame detectors would mistakenly indicate flame "ON", even when certain burners are not in service. The cause was determined to be interfering signals from nearby burners, and the system's inability to distinguish them from the target flame. This created a potential risk to safe boiler operation.

### Challenge

Ideally, a flame scanner should be able to isolate the target flame's signal from the adjacent and opposite burners. However, this is not always the case, and it cause's a dilemma in setting flame detection parameters. For many, the normal practice is to set the detector parameters to low load

conditions at the boiler. Unfortunately, when conditions change to a high load scenario, the flame detector tend to pick up signals from nearby burners. On the other hand, if the flame detection parameters are set at high load conditions, the detector will lose sensitivity and indicate flame “OFF” at lower load conditions.

### Solution

Typical flame detectors work by analyzing pulse (flicker) frequency and the pulse magnitude of the target flame. As long as the target flame’s signals are above the user defined thresholds for these parameters, the detector will indicate flame ON. In multiple burner applications, where boiler load conditions vary, the pulse frequency and pulse magnitude are not always enough to qualify flame status. To achieve enhanced discrimination, the EZ Flame detector system utilizes an additional criteria that is unique to the target flame to qualify whether it is ON or OFF.

In general, the combustion flame is divided into three regions: the base, primary, and the outer combustion zones. The most intense ultraviolet radiation and high frequency infrared energy is radiated at the base combustion zone. However, it is not necessarily the most stable. As seen in the table below, flame characteristics will vary at each zone.

	<b>Base Combustion Zone</b>	<b>Primary Combustion Zone</b>	<b>Outer Combustion Zone</b>
<b>Pulse Frequency</b>	High	Medium	Low
<b>Pulse Amplitude</b>	High	Medium	Low
<b>Flame Intensity</b>	Low	Medium	High

While viewing the primary combustion zone, the EZ-Flame detector analyzes the target flame signals to meet the three following criteria:

1. Flame Pulse Frequency (FREQ): Within the primary combustion zone of the target flame, the flicker frequency will be significantly different (higher) than those generated by the outer combustion zones of the adjacent and opposite burners, as well as, radiation from the fire ball. The user can assign a unique flicker frequency range (FREQ) to qualify the target signal.

2. Flame Pulse Amplitude (AC): Within the primary combustion zone of the target flame, its pulse amplitude will be significantly different (higher) than those generated by the outer combustion zones of the adjacent and opposite burners, as well as, radiation from the fire ball. The user can assign a unique amplitude (AC) range to qualify the target signal.

3. Flame intensity (DC): Within the primary combustion zone of the target flame, the flame intensity will be significantly different (lower) than signals generated by the outer combustion zones of the adjacent and opposite burners, as well as, radiation from the fire ball. The user can assign a unique intensity (DC) band to qualify the target signals.

Only when all three criteria above are met, will the flame detector send a flame “ON” signal.

### **Result**

SafeFire’s EZ-FLAME detectors were able to meet the customer's requirements:

1. Under various boiler load conditions, the EZ-Flame detector was able to detect the flame of the target burner accurately without influence from the adjacent and opposing burners.
2. Under various boiler load conditions, the EZ-Flame detector was able to detect the flame of the target burner accurately without picking up signals from the fire ball.
3. Replacement of 96 flame scanners and corresponding amplifiers was successfully completed on schedule, and performed to customer specifications.

### **Benefit**

EZ-Flame’s enhanced signal analysis and tuning capability accurately detected target flames in this very challenging boiler environment, which significantly improved safety and reliability for the customer.