**EZ-FLAME DETECTION UNIT**

**CASE STUDY**

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**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.

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**SITUATION**

The Rabigh Power Plant Project in Saudi Arabia consists of 2x660MW subcritical oil powered boilers. They are 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 consists of six swirl burners. The swirl burners ignite in two stages: first, the light oil igniters are engaged. Second, the main burners (running on heavy oil) are started. Each burner uses steam atomization and has an output rating of 3210KG / hr.

Each boiler utilizes 96 infrared flame scanners; 48 sets monitor the igniter flames, and the other 48 monitor the main burner flames. The existing flame detectors installed at the Rabigh Power plant had difficulty confirming their target flame status.

When operating at high-load conditions, the boiler’s flame detectors mistakenly indicated that the flame is “ON”, even when certain burners were not in service. It was determined that signal interference by the nearby burners was the culprit. In addition, at high-load conditions, the system was unable to differentiate between the target flame and the adjacent burners. This misdiagnosis created a potential risk to safe boiler operation.

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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 creates a dilemma in setting the flame detection parameters. For most boilers, the typical practice is to set the detector parameters for low load conditions. Unfortunately, when conditions change to a high load scenario, the flame detector tends to pick up signals from nearby burners. However, if the flame detection parameters are set for high load conditions, the detector loses sensitivity and indicates that the flame “OFF” during lower load conditions.

SOLUTION

Typically, flame detectors work by analyzing a target flame’s pulse (flicker) frequency and pulse magnitude. 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 trigger flame status. To achieve enhanced discrimination, the EZ Flame Detector System utilizes additional unique criteria to qualify whether the target flame is “ON” or “OFF”.

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

<table>
<thead>
<tr>
<th>BASE COMBUSTION ZONE</th>
<th>PRIMARY COMBUSTION ZONE</th>
<th>OUTER COMBUSTION ZONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PULSE FREQUENCY</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>PULSE AMPLITUDE</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>FLAME INTENSITY</td>
<td>Low</td>
<td>Medium</td>
</tr>
</tbody>
</table>
While viewing the primary combustion zone, the EZ-Flame Detector analyzes the target flame’s 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 any adjacent and/or 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 any adjacent and/or 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 any adjacent and/or 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 installed and provided solutions to the customer’s service issues:

1. Under various boiler load conditions, the EZ-Flame Detector accurately detected the burner’s target flame without interference from the adjacent and/or opposing burners.

2. Under various boiler load conditions, the EZ-Flame Detector accurately detected the burner’s target flame 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 highly challenging boiler environment, which significantly improved safety and reliability for the customer.