Continuous Emission Monitoring In-Situ System

South Carolina Electric & Gas Power Plant

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Procal have many years of experience in emission measurements from a wide range of combustion sources and have over 2000 hundred PULSI 200 instruments fitted on many types of utility power plants worldwide. Procal has developed a stack mounted multi component analyser that features a unique In-Situ sample cell with an enveloped folded beam and is connected through a digital link to an industrial PC (Analyser Control Unit). The stack mounted emissions analyser has been designed to operate with minimal maintenance in harsh environments.

South Carolina Experience

Power Plant: McMeekin
Operator: South Carolina Electric & Gas
Capacity: 294MW
Location: Columbia, South Carolina, USA

The following data was collected from an instrument installed on a power plant in South Carolina as part of a test to demonstrate that the MCERTS approved PULSI 200, Multi-Component, In-Situ, Continuous Emission Monitoring Analyser complies with the US EPA stack emission monitoring requirement 40 CFR Part 75, for utilities.

The power plant currently uses an extractive CEM system that is mounted at the base of the stack in an air conditioned shelter. The flue gas sample is extracted from the 150ft (46m) stack level through a long length of sample gas line, to the rack mounted system located in a large air conditioned shelter. The extractive system requires a significant amount of maintenance on a daily basis to ensure that it remains fully compliant.

Procal Trial Installation

The PULSI 200 Continuous Emission monitoring system was calibrated as follows:

<table>
<thead>
<tr>
<th>Range</th>
<th>Gas</th>
<th>Calibration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NO</td>
<td>0 - 500ppm</td>
</tr>
<tr>
<td>2</td>
<td>NO2</td>
<td>0 - 250ppm</td>
</tr>
<tr>
<td>3</td>
<td>SO2</td>
<td>0 - 2000ppm</td>
</tr>
<tr>
<td>4</td>
<td>CO2</td>
<td>0 - 20%</td>
</tr>
<tr>
<td>5</td>
<td>H2O</td>
<td>0 - 10%</td>
</tr>
</tbody>
</table>

Sample temperature 150°C

The installation consisted of the PULSI 200 stack mounted analyser and an Auto Verification Unit (AVU).

The Analyser Control Unit (ACU), was mounted at the base of the stack to display and re-transmit the measured concentrations and provide a daily log of zero and calibration accuracy.
The Auto Verification Unit (AVU) houses three solenoid valves to enable zero, cal. gas 1 and cal. gas 2 to be introduced into the probe to carry out automatic zero and span calibration verification. This is the only method of zero and span calibration approved by the EPA. The emission monitoring system is fully verified by this unit.

The In-Situ sample cell is protected by a pair of sintered filter panels which allow stack gas to pass into the cell, but exclude the passage of any particulate matter that may be present in the sample stream. The sintered panels provide protection for the measuring cell and do not normally have to be cleaned or changed during the life of the instrument.

The zero and span gases are introduced through a tube connected to the In-Situ sample cell and the positive pressure of the gas flow purges out the stack gas. In addition to the calibration function, this action also back purges the sintered filter panels. The sample temperature and pressure in the sample cell are continually monitored allowing automatic corrections for any process fluctuations. It also monitors the condition of the sintered filter panels without the need for probe removal or downtime.

**Analyser Control Unit**

The concentrations of monitored gas species along with diagnostic data displayed on the analyser Control Unit. This information then retransmitted to a PC running Procal ACW software, which facilitate the long-term data logging requirements and remote data interrogation functions.

The Analyser Control Unit is contained in a wall or 19" rack mounted aluminium IP65 / NEMA 4x enclosure and includes a 24V DC power supply unit that can support up to 4 analysers.

**Analyser Installation**

The analyser was mounted on the stack at the 150ft (46m) level in an existing sample port normally used for annual compliance testing.

The power plant engineers were impressed with the unit from the outset not only because the analyser was able to carry out the measurements, which previously required a large complex extractive system, but also by the ease of installation, which was easily carried out in one day.
It is a requirement of US EPA 40 CFR Part 75 that the instrument is demonstrated to be in compliance on a daily basis.

Both the zero and calibration test are carried out once every 24 hours, this is achieved automatically by activating a solenoid valve to introduce instrument air into the probe, to verify that the zero point is within \( \pm 2\% \). The test is then repeated using test gas to verify the span of each of the ranges is within \( \pm 2\% \). As can be seen over the three-month trial period, every point was within specification, therefore no span adjustment was required. It is also worth noting that there was no maintenance carried out on this instrument during the trial period.

**Relative Accuracy**

The relative accuracy of the instrument was demonstrated by comparison with the extractive system, which is annually subjected to a full RATA compliance test. A back up extractive CEM was also installed to ensure > 95% up time and to provide any missing data that Part 75 requires. The In-Situ Analyser was mounted in the ports used for the annual RATA tests on the permanent site CEM system.

**Daily Averages**

To verify the relative accuracy the output of the PULSI 200 was compared with the output of the extractive system. Fig 2 shows the comparison over one month by trending the daily average of both the In-Situ and extractive systems.

The average difference:  

<table>
<thead>
<tr>
<th></th>
<th>SO2</th>
<th>NOx</th>
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<tbody>
<tr>
<td></td>
<td>2.2%</td>
<td>1%</td>
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</tbody>
</table>

**Hourly Averages**

A week was chosen at random and the hourly averages were compared as shown in fig 3.

The average difference:  

<table>
<thead>
<tr>
<th></th>
<th>SO2</th>
<th>NOx</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.18%</td>
<td>7%</td>
</tr>
</tbody>
</table>

These results demonstrated that two systems using different measurement principles (Chemiluminescence / UV absorbance) and different sampling techniques (In-Situ enveloped folded beam / Dilution extractive) gave results well within the requirements of the US EPA 40 CFR 75 relative accuracy requirements. Users operating under part 75 regulations have two choices: demonstrate a system performance better than 10% relative accuracy with quarterly audits and annual relative accuracy testing or eliminate quarterly audit testing completely by demonstrating a performance of better than 7.5% relative accuracy.

**Conclusion**

The trial demonstrated that the Procal CEM In-Situ system performed reliably, within specification and compared extremely favourably when compared to the extractive system. The installed cost of the In-Situ system with its small footprint and maintenance costs are considerably less than traditional extractive systems.

The trial showed that the PULSI 200 can also comply with rigorous compliance testing and therefore meets the requirements of Environmental Agencies worldwide, both today, and as may be legislated in the future.