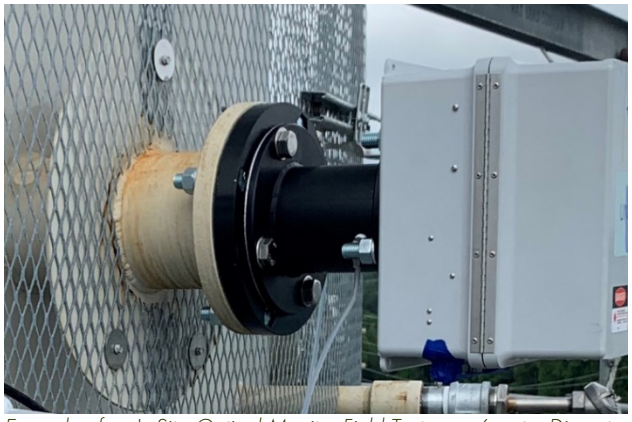
In-Situ Optical Monitor Test Facility



Example of an In-Situ Optical Monitor Field Test on a 6-meter Diameter Stack Using a 0.16-meter Path Length Calibration Cell

- Address potential limitations and safety concerns by assessing alternate QA/QC test conditions
- Conduct objective, third-party performance evaluations through an in-situ optical monitor test facility
- Provide participants an improved understanding of optical CEM performance

Key Research Question

Assessing the potential value of applying in-situ optical monitors in a continuous emissions monitoring capacity starts with developing a better understanding of how to best operate the technology within the current regulatory framework. A recent *in-situ* optical monitor demonstration on the stack of a gas turbine combined cycle (GTCC) demonstrated the accuracy of the technology and its capability to serve as a continuous emissions monitor (CEM). Significant CEM operations and maintenance (O&M) cost savings have been estimated by virtue of the elimination of the sample probe, heated umbilical sample transport line, sample pump, and flue gas conditioning systems, as well as due to reduced calibration gas and electrical power requirements associated with current extractive based CEM systems.

In order for *in-situ* optical monitors to be applied in a CEM capacity, they need to operate within the current regulatory framework associated with CFR40 Parts 60 and 75. Current QA/QC daily calibration and linearity tests require *in-situ* optical monitors to be evaluated on the basis of an equivalent number of molecules (i.e., ppm-meters) within the in-line calibration cell relative to target ppm-meter concentrations over the measurement path length. This requirement of equivalent ppm-meters can constrain the ability to achieve required concentrations based on the scaling of the calibration cell and measurement path lengths due to gas concentration limits (e.g., 30% O_2 or 100% CO_2), as well as potential safety limits associated with NO, NO_2, CO, and NH_3.

The current project is focused on comparing ppm-meter and ppm specie measurements within an *in-situ* optical monitor test cell capable of being operated over a range of temperatures and simulated flue gas concentrations that also include moisture.

Objective

The project objective is to evaluate whether CEM QA/QC requirements can be met based on equivalent ppm concentrations as a percent of span within an in-line calibration cell, versus on a ppm-meter basis. The proposed project will focus on measurements of O_2, CO_2, CO, NO, and NO_2.

Approach

The anticipated approach will be to first fabricate, then perform tests, at a laboratory multi-path *in-situ* optical test facility that is capable of being operated over a range of temperatures and simulated flue gas concentrations. The current project will generate data in support of discussions with the U.S. Environmental Protection Agency (EPA) regarding appropriate QA/QC requirements for *in-situ* optical monitors used in a CEM capacity. A key series of tests will be conducted to evaluate the linearity of different optical monitors' response over a range of target specie concentrations and path lengths. Initial testing will be conducted with fiber coupled near-infrared laser optical monitors capable of measuring O_2, CO_2, and CO. A second series of tests will demonstrate NO and NO_2 measurement linearity using a non-fiber coupled UV-DOAS monitor. By

demonstrating optical monitor linearity using a constant EPA-certified reference gas concentration over different path lengths (i.e., different ppm-meter concentrations), or different EPA-certified gas concentrations over a constant path length, the equivalency between ppm and ppm-meter tests of optical monitor response can be assessed.

Research Value

Completion of the project scope is intended to provide the data necessary to support discussions with EPA regarding appropriate *in-situ* optical monitor QA/QC test conditions, while also addressing potential reference cylinder gas concentration safety concerns that can arise with current ppm-meter QA/QC test requirements. In addition, fabrication of an objective third-party *in-situ* monitor test facility provides opportunity to test *in-situ* optical monitor performance under realistic measurement conditions (e.g., temperature and specie concentrations). Public benefits from this project may include improved accuracy and cost effectiveness associated with CEM measurements through use of advanced measurement technology.

Deliverables

All project funders will be invited to participate in periodic project webcasts to review the *in-situ* optical monitor test facility design and capabilities, along with test results obtained in support of regulatory discussions with EPA regarding *in-situ* optical monitor systems applied in a CEM capacity.

Price of Project

The total project cost to fabricate an *in-situ* optical monitor test facility and conduct tests to evaluate the equivalency of ppm and ppm-meter QA/QC tests is estimated at $150,000. EPRI is seeking at least six participants at a cost of $25,000 each. The project qualifies for Self-Directed Funding (SDF) and Tailored Collaboration.

Project Schedule

Initiation of the project is subject to attainment of enough utility participants by June 30, 2023, with the anticipated initial project scope and schedule to be completed by March 31, 2024.

Who Should Join

Utilities with gas turbine and/or coal-fired unit CEM systems that are currently assessing CEM replacements could benefit from participation in this project.

Contact Information

For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com).

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