CONTINUOUS EMISSION MONITORING: DESIGN, OPERATION AND EXPERIENCE

A SPECIALTY CONFERENCE ON:

CONTINUOUS EMISSION MONITORING - DESIGN, OPERATION AND EXPERIENCE

EDITED BY

THE AIR POLLUTION CONTROL ASSOCIATION

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A Specialty Conference On:

CONTINUOUS EMISSION MONITORING -
DESIGN, OPERATION AND EXPERIENCE

November 8-11, 1981, Denver, CO

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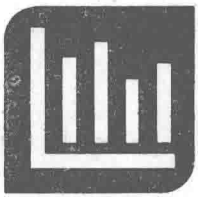

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CONFERENCE INTRODUCTION

James A. Jahnke
Northrop Services, Inc.
Research Triangle Park, North Carolina

The idea for this meeting evolved about a year and a half ago with Committee TP-7, the Source Measurements Committee, of the Air Pollution Control Association. Committee members had seen at that time that there was substantial progress being made in the field of continuous emission monitoring. The last conference on continuous emission monitoring, which was held in St. Louis, in March of 1975 had done much to start the dissemination of information about source monitoring systems; but then on October 6, 1975, Performance Specification Procedures were promulgated by EPA and the field began to progress rapidly. Since that time, a lot has been learned by many people - both agency people and people in industry. Rapid progress has been made in instrumentation and with many of the regulations.

What we had intended a year and a half ago was to try, in this conference, to answer a basic question: What is the state of the art of continuous emission monitoring? In selecting papers and asking people to present papers, we didn't really want to have research papers where we would look at details of research prototype instrumentation. Instead, we wanted to see where we are. What are we doing with what we have now in terms of instrumentation? What does it take to keep that type of instrumentation going? For that reason, we came up with four sessions.

We have a session on industry experience: What is the experience of the utilities and other industries with the use of these monitors? We also have a session on regulatory approaches towards continuous monitoring: How do the agencies want to use continuous monitors in their programs; what is the future actually going to be, in terms of agency demands on continuous emission monitors? Then we have a session on instrumentation and testing. We included papers, by consultants, concerning the work that they have been doing with continuous monitors. Here we did include papers dealing with instruments that are coming onto the market. However, they are not research prototypes, but are actual working systems.

Finally, and most importantly for this conference, we have a session on quality assurance procedures. In ambient air monitoring, quality assurance programs have been well established. But quality assurance is a relatively new idea to continuous emission monitoring, and there is a lot of action now to implement quality assurance procedures in all phases of source emission measurement. Quality assurance is one of the most important programs needed to be implemented within the agencies and within the utilities, in order to keep the systems operating continually.

In this conference we want to focus on experience. What are people doing with continuous emission monitors? What are their quality assurance methods, and what are the characteristics of successful systems? What has happened in the past to make systems unsuccessful? We want to learn from other people's mistakes; learn what people are doing now to get those systems going. We want to have a better understanding of what we can expect from CEM systems with regard to what we put into them: What does it take in terms of manpower to keep these systems going, and if we put in that manpower, what kind of system will we then have? I hope that some of these questions can be answered here.

Also, I hope that we can get a better understanding of what we can expect in the future, both from the new systems that will be developed and from the agency programs.

I'd like to welcome you, and I anticipate that we will have a very successful meeting in terms of the information presented during the three days of the conference.

THE ELECTRIC UTILITY INDUSTRY'S EXPERIENCE WITH CONTINUOUS EMISSION MONITORS

Robert P. Finch, P.E.,

Dennis R. Swann, P.E., Stearns-Roger Engineering Corporation and Charles E. Dene, Michael W. McElroy Electrical Power Research Institute (EPRI)
Jack Taylor, Edison Electric Institute (EEI)

This paper presents the results from an evaluation of continuous emission monitors (CEM). The evaluation, sponsored by EEI and EPRI, critically examines all aspects of responding to current CEM regulations, beginning with the initial interpretation of continuous monitoring legislation by a prospective CEM user to the cost of operating an installed monitoring system.

From a utility user's standpoint, compliance with CEM regulations poses a myriad of unforeseen technical and administrative problems which translate into high costs of operating and maintaining a CEM system. Some of the more common problems are presented and the utility efforts to solve them are discussed. Recommendations for improving the utility CEM experience are suggested.

The objective of the CEM evaluation was to review and evaluate the utility industry's experience with CEM and clarify the related problems, issues, and experiences.

INTRODUCTION

Stearns-Roger Engineering Coporation, under contract with EEI and EPRI gathered data through meetings with EPA representatives, a working conference with members of the utility community, site visits to vendor's plants, use of existing literature and surveys, site visits to utilities installations, and use of a subcontractor, Entropy Environmentalists, Inc.

In order to gather constructive data, the acquisition of operational information was limited to installations considered acceptable. An acceptable installation, for purposes of this work, was defined as one which had been certified by the EPA and demonstrated a high availability (greater than 90 percent).

The specific areas considered included, 1) Present usage of CEM, 2) Major problems, 3) Suggested solutions, 4) Maintenance requirements, 5) Maintenance experience, 6) Specification considerations and, 7) Trends in CEM.

A comprehensive report based upon this evaluation is presently being published by EPRI. This paper presents a summary of this report.

BACKGROUND

Continuous emission monitors (CEM) have been required by Federal New Source Performance Standards (NSPS) on all utility fossil fuel steam generators (FFSG) greater than 250 M Btu heat input constructed since December, 1971. Originally they were designated only as indicators of the performance of environmental control equipment. The latest revisions to the NSPS, however, may require that all FFSG's constructed since September, 1978 use their CEM as a means for determining compliance with emission standards. Figure 1 is a flow chart for determining CEM requirements.

The Environmental Protection Agency (EPA) is interested in a program that achieves sustained emissions reduction. In order to accomplish this it is expected that the CEM will have an ever-increasing role in monitoring and in determining compliance with emission regulations.

There are three basic incentives for a utility to install a CEM:

The Federal or State regulations require it.

There is a high level management commitment to monitor emissions.

Enhancement of performance evaluation and process control, such as SO_2 removal, using CEM.

Utilities have installed opacity, SO_2, NO_x, O_2, and CO_2 monitors mainly to meet the regulations of the EPA or local regulating authorities.

Continuous Emission Monitor (CEM)

A continuous emission monitoring system, as discussed herein, is defined as consisting of three major subsystems:

a. Sampling Interface - The portion of a continuous monitoring system that samples the pollutant and protects the analyzer from the effluent.

b. Analyzer - That portion of the continuous monitoring system which senses the pollutant and generates a signal output that is a function of the pollutant concentration.

c. Data Recorder - That portion of the continuous monitoring system that processes analyzer output and provides a permanent record of the output signal in terms of concentration units.

EPA Philosophy on Continuous Emission Monitoring

The EPA, in the preamble to the promulgation of 40 CFR 51, discusses their rationale for requiring emission monitoring.[1] EPA explains that the emission monitoring and reporting requirements are "designed to partially implement the requirements of Sections 110(a)(2)(F)(ii) and (iii) of the Clean Air Act, which state that implementation plans must provide 'requirements for installation of equipment by owners or operators of stationary sources to monitor emissions from such sources,' and 'for periodic reports on the nature and amounts of such emissions.'

In discussing the need for a continuous emission monitoring system, the EPA states that regulatory agencies historically had to rely on infrequent manual source tests and periodic field inspections to provide much of the information necessary to ascertain the compliance status of sources. The discussion also includes the shortcomings of using infrequent manual source tests as indicators of continuous compliance with emission limitations. Their major concern with the use of manual source tests was the inability to be representative of all operating conditions. Having discussed the problems associated with historical source surveillance/compliance determination techniques, the advantages of continuous emission monitoring systems were outlined. These advantages include:

(1) providing a continuous record of emissions under all operating conditions;

(2) a good indicator of whether a source is using good operating and maintenance practices to minimize emission to the atmosphere;

(3) providing a valuable record to indicate the performance of a source in complying with applicable emission regulations:

(4) signaling of a plant upset or equipment malfunction so that the plant operator can take corrective action to reduce emissions; and

(5) under certain conditions, data may be sufficient evidence to issue a notice of violation.

EPA summarized their position on continuous emission monitoring by stating, "Use of emission monitors can therefore provide valuable information to minimize emission to the atmosphere and to assure that full-time control efforts, such as good maintenance and operating conditions, are being utilized by source operators." Table 1, the EPA reviewers check list, provides a detailed list of items that the EPA considers important for reviewing reports.

[1]Requirements for the Preparation, Adoption, and Submittal of Implementation Plans, Federal Register, Vol. 40, No. 194, Monday, October 6, 1975.

States have been ordered under the Clean Air Act Section 110(a)(2)(c) as amended August 1977, to develop local CEM requirements. Some have developed, or are in the process of developing emission enforcement programs using CEM data. In addition, some states have interpreted CEM to be emission compliance indicators, contrary to the EPA's intent. Some states also impose more stringent CEM requirements than those of the EPA.

The cost of noncompliance with emission regulations may include fines, temporary load reductions, and shutdown of generating units, together with the resulting costs for purchased power or operation of less efficient units. The Clean Air Act as Amended August 1977, Section 120, carries the potential for financial penalties for violation of emission standards.

Given the growing role of CEM as a sole emission compliance indicator, it is imperative that CEM perform accurately on daily utility operations. Historically, CEM have not demonstrated these qualities.

UTILITY CEM EXPERIENCE

In general, utilities have had rather poor experience with the installation, operation, maintenance, and certification of CEM. Capital costs have been higher than expected and maintenance costs have been beyond their worst expectations. Utility experience with CEM's has shown that they are expensive, have high maintenance requirements, exhibit relatively poor availability, are very difficult to certify, provide poor data, and are generally very complicated systems.

Compared to the typical power plant type instrument, such as a flow orifice, transducer, and indicator, a CEM package (opacity, SO_2, NO_x, and diluent monitors) costs 25 to 50 times more to purchase and install. The reason for this is that the CEM is a very sophisticated and complex device including sampling equipment, sophisticated electronics for automatic calibration, and often delicate optical components.

A full-time technician is required to maintain a single CEM package of four instruments and associated equipment, whereas six to eight instrument technicians can maintain all of the instruments and controls for a total power generating unit which typically includes 6000 to 8000 instruments and a myriad of controls.

Target availability (actual operating time) for the best maintained and most carefully engineered CEM system is presently 95 percent availability. However, many utilities have had difficulty reaching 80 to 85 percent availability. In instances where CEM maintenance was not a priority, utilities often experienced 50 percent availability.

These figures should be considered when comparing CEM to other typical plant instrumentation such as flow transducers, which traditionally are expected to (and do) average better than 99.9 percent availability. Studies have shown that entire power plant process computers have availabilities of over 99 percent with less maintenance required than for CEM.

In many cases, utilities have tried to act in good faith. But, because of a misunderstanding of the requirements, poor equipment performance, or