Module 1: Introduction to Continuous Monitoring Systems (CMS)

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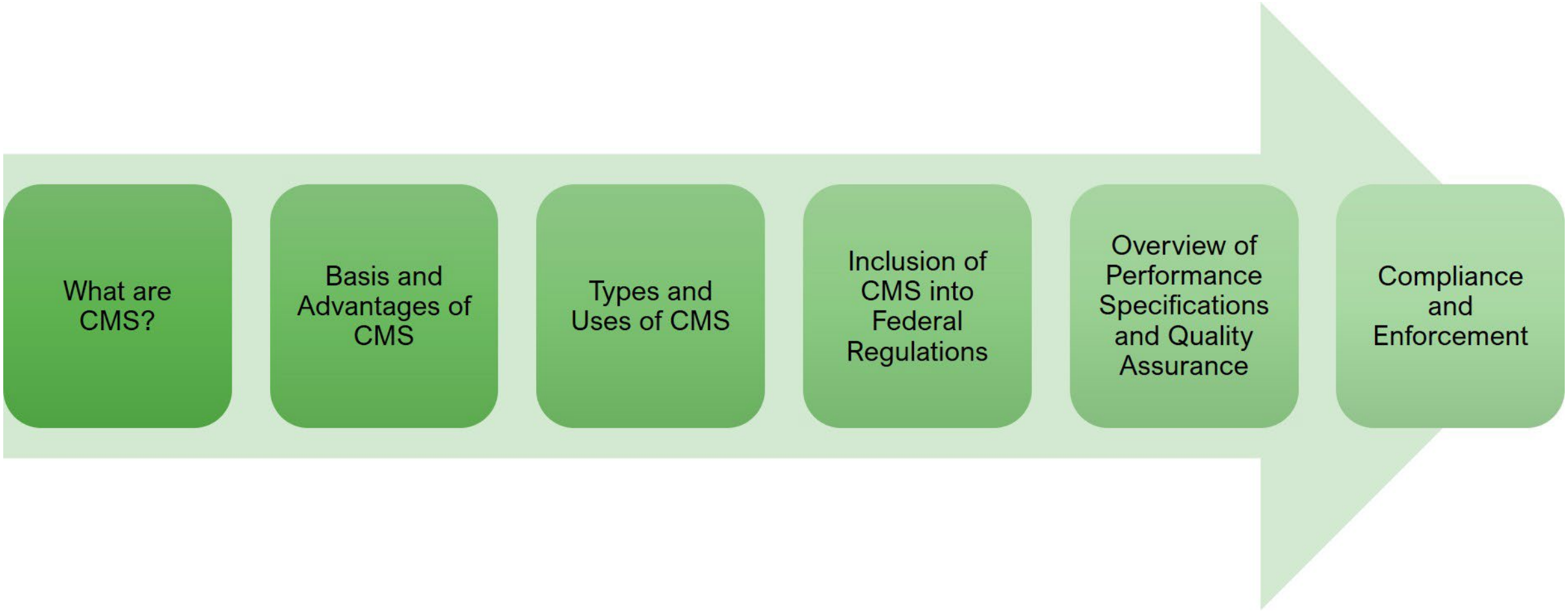
Module 1 Outline



Module 1 Learning Objectives

At the end of Module 1, learners will be able to:

- Recognize the different types and uses of CMS
- Identify the regulations that contain CMS requirements
- Recognize, in general, what performance specifications are and how they are used
- Recall enforcement aspects of CMS

What are CMS?

Continuous monitoring systems (CMS) **means "the total equipment, required under the emission monitoring sections in applicable subparts, used to sample and condition (if applicable), to analyze, and to provide a permanent record of emissions..."*40 CFR Part 60***

Why CMS?

CMS are required under some of the EPA regulations for either continual compliance determinations or determination of exceedances of the emissions standards.

The individual subparts of the EPA rules specify the reference methods that are used to substantiate the accuracy and precision of the CMS.

Basis for CMS Programs

- As a result of the Clean Air Act (CAA), many pollution control devices such as baghouses, scrubbers, and electrostatic precipitators have been installed.
- After the equipment is installed and operating, an air pollution control agency needs to know if the equipment is actually reducing emissions and if the facility is meeting its emissions standards.
- CMS programs are one of the methods used to measure emissions from stationary sources.

Basis for CMS Programs (Cont'd)

EPA established two methods to measure concentrations of pollutants from regulated sources:

Reference Methods

Reference methods are beneficial, but may have disadvantages when compared to using a CMS:

- Performed infrequently and for a relatively short period of time (hours)
- Often conducted when the source is operating under optimal conditions, which may not result in producing normal, day-to-day emission values

CMS

CMS have become an important part of a facility's compliance demonstration. The advantages of CMS are:

CMS Are Used To…

- Demonstrate compliance with regulations
- Generate data that can be used to develop regulations
- Improve emission databases
- Monitor control equipment operation
- Monitor process operating parameters
- Identify periods of excess emissions
- Assess control equipment efficiency
- Validate emission credits
- Provide public assurance

Types of CMS

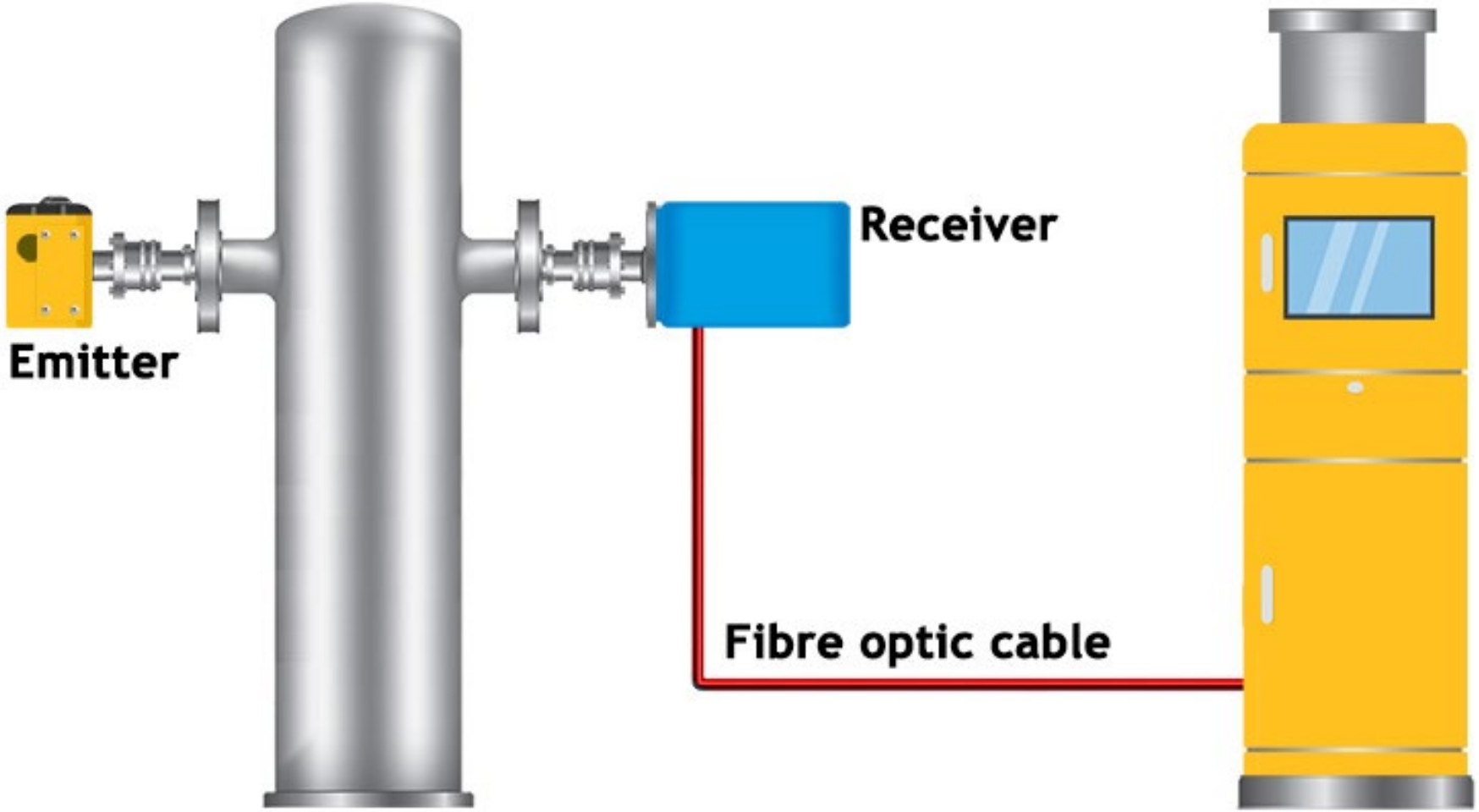
- The four types of CMS:
  - Continuous Opacity Monitoring Systems (COMS)
  - Continuous Emission Monitoring Systems (CEMS)
  - Predictive Emission Monitoring Systems (PEMS)
  - Continuous Emission Rate Monitoring Systems (CERMS)

Continuous Opacity Monitoring Systems (COMS)

COMS

- COMS consist of the **total equipment** used to sample, analyze, and provide a permanent record of opacity.
- COMS use light to determine opacity levels.
- Due to absorption and scattering of light by dust, smoke, and/or particulate present in the gas stream, there will be an attenuation of the transmitted light and a decrease in the light intensity that is measured.
- COMS can be “single pass” or “double pass.”

COMS (Cont'd)



Typical Sources with COMS Requirements

- COMS are typically used by facilities that rely on waste materials, oil, coal, wood, or other fossils fuels for combustion.

- Examples of sources are:
  - Utilities
  - Boilers
  - Flares

Continuous Emission Monitoring Systems (CEMS)

CEMS Definition

CEMS consists of the **total equipment** necessary to determine a gas or particulate matter emission concentration.

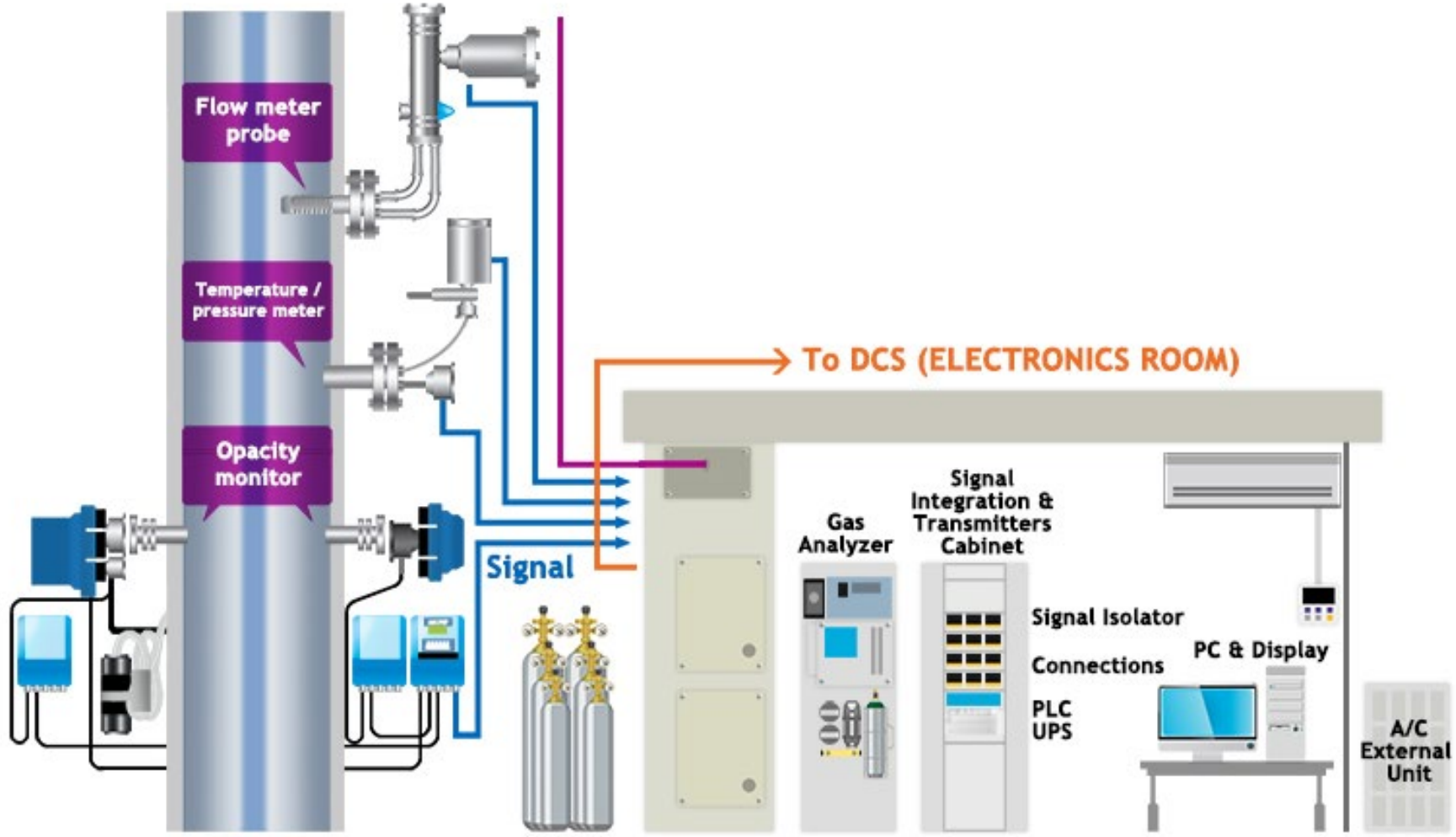
Image courtesy of Thermo Fisher Scientific™

CEMS

CEMS:

- Continuously measures actual emissions from stationary sources by extracting a sample of gas from the emission source:
  - Sample gas may be filtered, transported, conditioned, or diluted before being presented to the analysis system.
  - Gas concentrations are measured, recorded, and stored as data.
- May also include components for measuring particulate matter, and stack gas flowrate

CEMS: Illustrative Example



Basic CEMS Components

CEMS consist of the following:

Sample Interface. The portion of the system that is used for one or more of the following:

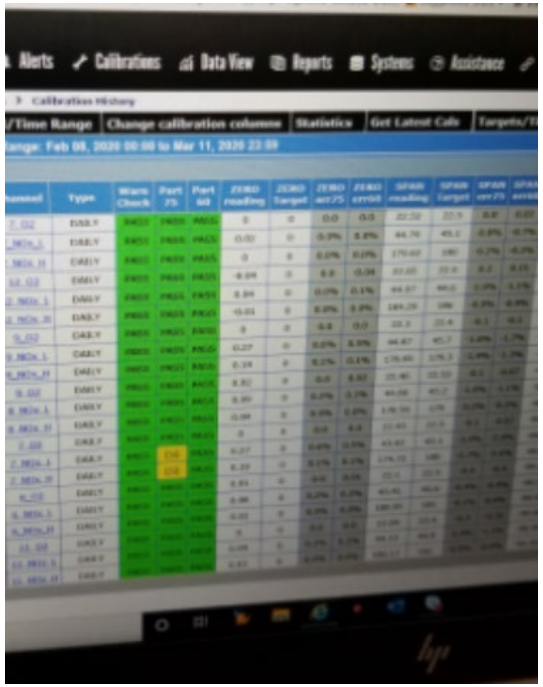
sample acquisition,
sample transportation,
sample conditioning, or
protection of the analyzer from the effects of the stack effluent.

Analyzer/Measurement Method. The portion of the system that senses the gas or particulate and generates an output proportional to the gas or particulate concentration.

Data Acquisition System. The portion of the system that records a permanent record of the measurement values. The data acquisition system, or DAS, may include automatic data reduction capabilities.

Major Components of CEMS

- Sample Probe
- Filter
- Sample Line (umbilical)
- Gas Conditioning System
- Calibration Gas System
- Gas Analyzers (may include more than one)
- Data Acquisition Systems (DAS)



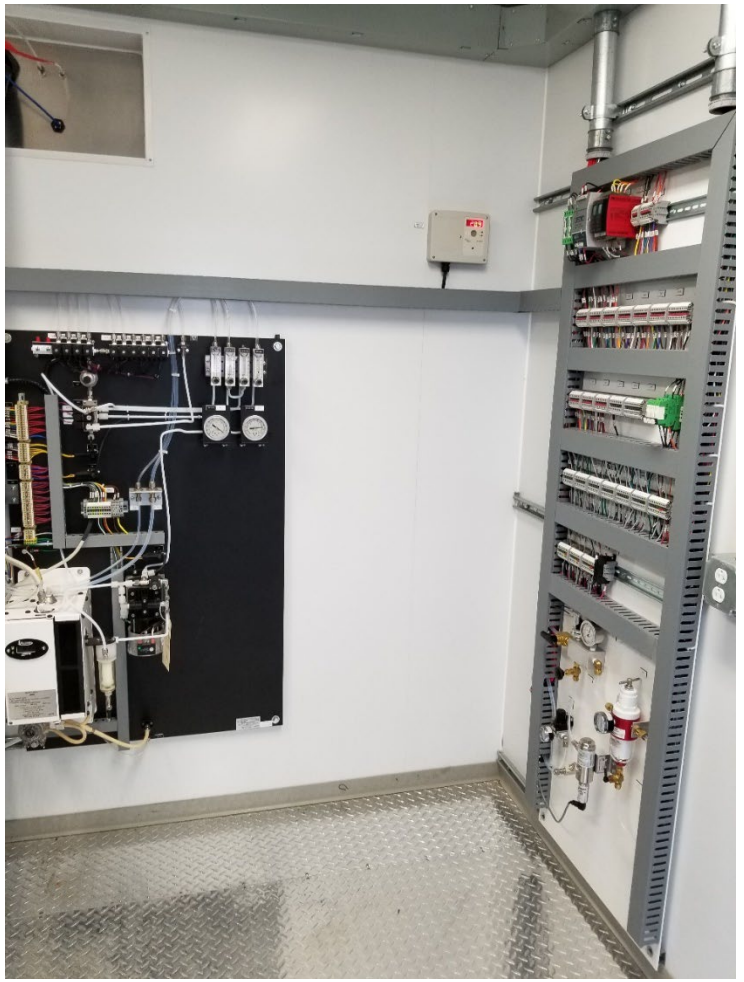
Data Acquisition System

Extractive Conditioning System

Gas Analyzers

Cylinders of EPA Certified Gases and CEMS Cabinet

Cylinders of EPA Certified Gases



Inside a CEMS Shelter

Outside a CEMS Shelter

CEMS Unit Shelter

Typical Sources with CEMS Requirements

CEMS are generally required on larger emitting stationary sources. Below are a few examples:

- Utilities
- Cement Plants
- Municipal Waste Combustors
- Nitric and Sulfuric Acid Plants
- Petroleum Refineries
- Copper, Zinc, and Lead Smelters
- Steel and Ferroalloy Plants
- Kraft Pulp Mills
- Glass Manufacturing Plants
- Magnetic Tape Production
- Phosphate Plants

Predictive Emission Monitoring Systems (PEMS)

PEMS

- The **total equipment necessary** to predict an emission concentration or emission rate.
- The system may consist of any of the following major subsystems: sensors and sensor interfaces, emission model, algorithm, or equation that uses process data to generate an output that is proportional to the emission concentration or emission rate, diluent emission model, data recorder, and sensor evaluation system.

PEMS (Cont'd)

- **Software-based system** which uses process values as input variables to provide a real-time estimation of emissions by means of derived mathematical or statistical algorithm
- PEMS are an acceptable regulatory alternative to CEMS for source emission compliance in some regulations.

Examples of Input Variables

- Feed Type
- Firing Rate
- Fuel Gas Density
- Furnace Air Preheat Temperature
- Percent Excess Oxygen
- Stack Temperature
- Inlet Air Humidity
- Inlet Air Temperature

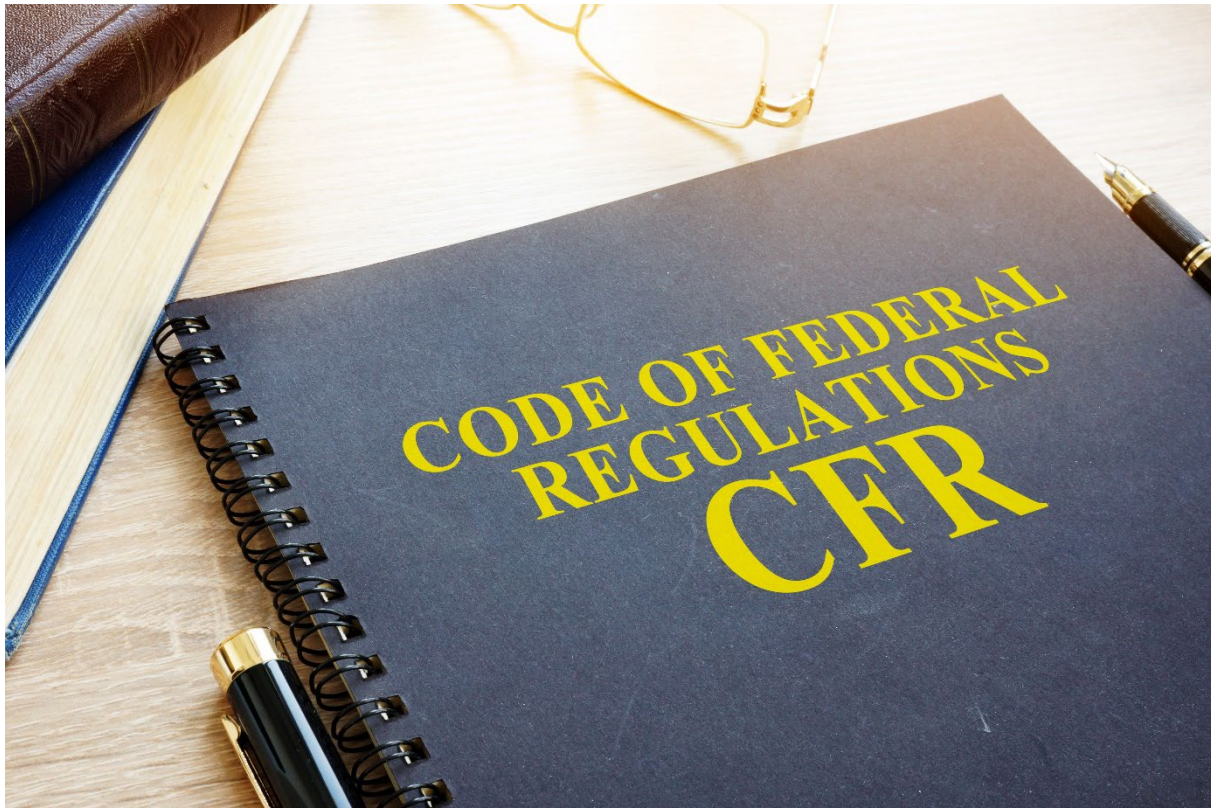
Continuous Emission Rate Monitoring Systems (CERMS)

CERMS

- Is the **total equipment required** for determining and recording the pollutant mass emission rate (in terms of mass per unit of time)

- Includes the use of a flow rate monitor to measure the volumetric flow rate of the emission stream and generate an output proportional to that flow rate

CMS in Federal Regulations



40 CFR, Part 60 - New Source Performance Standards (NSPS)

- CAA, Section 111 establishes mechanisms for controlling emissions of air pollutants from stationary sources:
  - Section 111(b) provides authority for EPA to promulgate new source performance standards (NSPS) which apply only to new and modified sources.
  - Section 111(d) requires regulation of existing sources.

- These standards limit the amount of air emissions (SO_2, NOx, etc.) that may be emitted from stack sources.
- The performance specifications and quality assurance procedures for CMS are found in Appendix B and F of 40 CFR, Part 60.

40 CFR Part 61 - National Emission Standards For Hazardous Air Pollutants (NESHAP)

- Established under Section 112 of the CAA
- Promulgated prior to November 15, 1990, the date of enactment of the CAA amendments of 1990
- National emission standards for hazardous air pollutants (NESHAP) contained in this part remain in effect until they are amended, and if appropriate, added to Part 63.

40 CFR, Part 63 - National Emission Standards for Hazardous Air Pollutants (NESHAP) for Source Categories

- Established under Section 112 of the 1990 amendments to the CAA
- These standards regulate specific categories of stationary sources that emit (or have the potential to emit) one or more hazardous air pollutants listed in this part.
- The standards in this part are independent of the NESHAP contained in 40 CFR Part 61.

40 CFR, Part 75 – Acid Rain Program

- Established under Title IV of the CAA of 1990
- First national cap and trade program in the country
- Requires major emission reductions of SO_2 and NO_X from the power sector
- SO_2 and NO_X are the primary precursors for acid rain.
- Since Part 75 is handled by EPA's Clean Air Markets Division (CAMD), the Part 75 monitoring requirements are not the focus of this training.

Performance Specifications and Quality Assurance

Performance Specifications are used for evaluating the acceptability of the CMS at the time of, or soon after installation, or whenever specified in the regulations.

Quality Assurance (QA) procedures are used to evaluate the effectiveness of quality control (QC) and the quality of data produced by any CMS that is used for determining compliance with the emission standards as specified in the applicable regulation.

Performance specifications and QA procedures can be found in 40 CFR, Part 60 Appendices B and F, respectively.

Use of CEMS Data for Enforcement

- CEMS can provide accurate data regarding a source's compliance with the emissions limits and standards.
  - CEMS data can be more representative of a source's ongoing compliance status when compared to infrequent performance testing, and
  - CEMS data typically can cover a greater percentage of a source's time in operation.

Use of CEMS Data for Enforcement (Cont'd)

CEMS data is important to enforcement, irrespective of whether the legal requirement being enforced specifies CEMS as the compliance method.

- The CAA authorizes EPA to bring an administrative, civil, or criminal enforcement action "on the basis of any information available to the administrator."
- The 1997 "Credible Evidence" revisions to 40 CFR Parts 51, 52, 60, and 61 clarified that non-reference test data, including CEMs, can be used for establishing whether or not the source has violated or is in violation of any standard of that part.

Enforcement Applications of CEMS

- The governing regulation* specifies CEMS as the compliance method.
- The governing regulation* specifies some method other than CEMS as the compliance method, or the governing regulation doesn't specify a compliance method.

* e.g., 40 CFR Part 60

CEMS is the Compliance Method

Required by some NSPS, National Emission Standards for Hazardous Air Pollutants (NESHAPS) and State Implementation Plans (SIPs)

Includes data validation requirements

Requires monitoring against emission limits with long averaging time

Data documents compliance against the emissions standard

CEMS is not the Compliance Method

CEMS data is “Credible Evidence:”

Data is used for initiating and supporting enforcement cases alleging emissions violations.

CEMs data may provide a basis to issue a Section 114 request for compliance method data.

CEMs data may be used to enforce operation and maintenance, monitoring and recordkeeping and reporting requirements, when the regulation does not specify a compliance method or an emissions standard (e.g. General Duty Clause).

Let’s Test Your Knowledge!

Feedback

True! In addition, CMS are also used to:

- Demonstrate Compliance with Regulations
- Generate Data that can be Used to Develop Regulations
- Improve Emission Data Bases
- Monitor Process Operating Parameters
- Validate Emission Credits
- Provide Public Assurance of Compliance

Types Of Continuous Monitoring Systems

1. CMS are used to identify periods of excess emissions, assess control equipment efficiency, and monitor control equipment operation.

True **False**

Feedback

It's true. CERMS are the total equipment required for determining and recording the pollutant mass emission rate (in terms of mass per unit of time).

Uses of CMS

1. CEMS are used for continuous compliance determinations or determination of exceedances of the standards.

True False

2. COMS use light to determine percent opacity.

True False

3. PEMS use direct measurements of emissions to determine results.

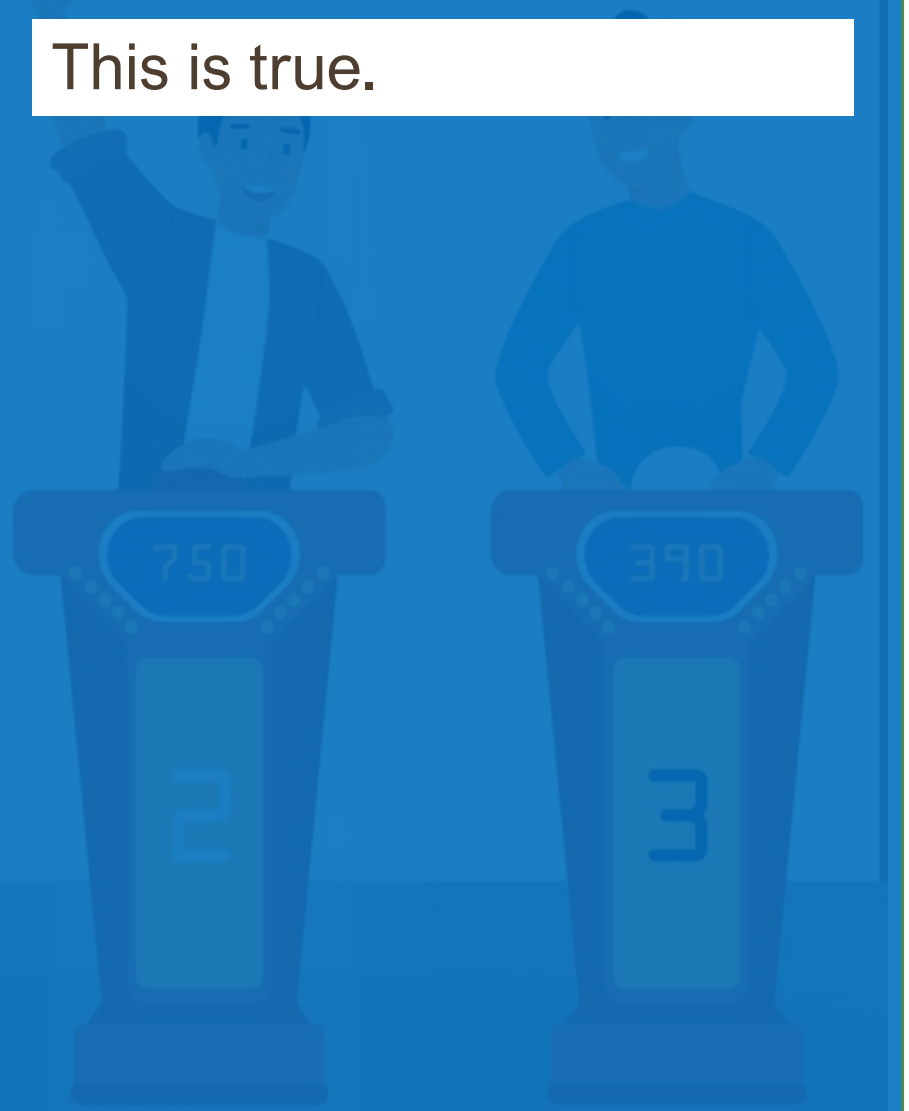
True False

4. CERMS determine and record the pollutant mass emission rate.

True False

Feedback

This is true.



Regulations – Question 1

1. The regulations that detail the monitoring, recordkeeping, and reporting requirements of the first national cap and trade program in the US are found in 40 CFR, Part 75- Acid Rain Continuous Emission Monitoring.

True **False**

Feedback

That's true. Performance specifications and quality assurance procedures for CMS are contained in Appendices B and F of 40 CFR, Part 60 – New Source Performance Standards.

Regulations – Question 2

2. Performance specifications and quality assurance procedures for CMS are contained in Appendices B and F of 40 CFR, Part 60 – New Source Performance Standards.

True **False**

Feedback

This is false. Performance specifications are used for evaluating the acceptability of the CMS at the time of, or soon after installation, or whenever specified in the regulations. The QA procedures are used to evaluate the effectiveness of quality control and the quality of data produced by any CMS.

Performance Specifications

1. Performance Specifications are used to evaluate the effectiveness of quality control and the quality of data produced by any CMS.

True

False

Activity

Title: Group Experts

Purpose: To become an “expert” on the knowledge learned from Module 1 for an assigned CMS. Share information and help your peers understand and retain this information.

Time: 40 minutes

- 20 minutes in groups
- 20 minutes group debrief

Activity Debrief

Module 1 Summary

Now that you have completed Module 1, you should be able to:

- Recognize the different types and uses of CMS
- Identify the regulations that contain CMS requirements
- Recognize, in general, what performance specifications are and how they are used
- Recall enforcement aspects of CMS