
All Carbon – All the Time

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Two-Part Presentation

- ◆ **Regulatory Overview and Update**
 - EPA's proposed new source performance standards
 - Status of CO₂ rule for existing coal-fired units
- ◆ **CO₂ Measurement/Accuracy Issues**
 - Volumetric Flow
 - CEMS Measurement Errors

NSPS Proposal

- ◆ In Fed. Reg. (January 8, 2014) – EPA withdrew its original proposal (April 13, 2013).
- ◆ In same issue of Fed. Reg., EPA proposed a revised version of standards of performance for electric generating units.

2014 NSPS Proposal

- ◆ Subpart Da – “Standards of Performance for Electric Utility Steam Generating Units”
- ◆ Subpart KKKK – “Standards of Performance for Stationary Combustion Turbines” - **OR** -
- ◆ Subpart TTTT – “Standards of Performance for Greenhouse Gas Emissions for Electric Utility Generating Units”

PC and IGCC Units

- ◆ **Design Heat Input > 250 mmBtu/hr**
- ◆ **> 10% Fossil Fuel Combustion for Any 3 Consecutive Years**
- ◆ **Supplies More than 1/3 of Potential MW and More than 219,000 MWh (net) to Grid on an Annual Basis**
- ◆ **Exemptions proposed for Certain Permitted Units:**
 - **Wolverine, Washington County, Holcomb EGU Projects**

Limits for PC and IGCC Units

- ◆ 1,100 lb CO₂/MWh (500 kg CO₂/MWh) based on 12-operating month rolling average or
- ◆ 1,050 lb CO₂/MWh (480 kg CO₂/MWh) based on 84-operating month rolling average.

CTs/Combined Cycle Units

- ◆ **Design Heat Input > 73 MW (250 mmBtu/hr)**
- ◆ **> 10% Fossil Fuel Combustion for Any 3 Consecutive Years**
- ◆ **> 90% Natural Gas Based on 3-Year Rolling Average**
- ◆ **Supplies More than One-Third of Potential MW and More than 219,000 MWh (net) to Grid Based on 3-year Rolling Average.**

CTs/Combined Cycle Units

- ◆ **Design Heat Input to Turbine > 850 mmBtu/hr**
 - 1,000 lb CO₂/MWh (450 kg CO₂/MWh)
- ◆ **Design Heat Input to Turbine > 250 mmBtu/hr and ≤ 850 mmBtu/hr**
 - 1,100 lb CO₂/MWh (500 kg CO₂/MWh)
- ◆ **Compliance based on 12-operating month rolling average.**

Status of Proposal

- ◆ **Comment Period Extended Until May 9, 2014**
- ◆ **Final Rule Maybe By End of June, 2015?**
- ◆ **Numerous Comments Expected**
- ◆ **Key Issues**
 - **Technical basis for proposed standards is shaky and possibly violates Energy Policy Act 2005.**
 - **CCS is not demonstrated at EGU scale**
 - **Proposal does not address modified units.**

Emission Guidelines for Existing Units

- ◆ **Section 111(d) Requires EPA to Develop Standards of Performance for Existing Units**
- ◆ **Timetable Set by Presidential Directive**
 - **June 1, 2014** – Proposed Standards
 - **June 1, 2015** – Final Standards
 - **June 30, 2016** – SIP Revisions Due

Rulemaking Package Received by OMB on 3/31/2014

Emission Guidelines for Existing Units

- ◆ **Basis = Best System of Emissions Reduction (BSER)**
- ◆ **Efficiency-Based Standard**
 - Work Practice for Modified Units?
 - CO₂ (lb/MWh) and/or Heat Rate (Btu/kWh) Standard?
- ◆ **What is BSER for Existing Units?**
 - Unit Heat Rate Improvements
 - Demand-Side Reductions
 - Capacity Shifting
- ◆ **EGU Reduction Targets by State, but Might Allow Regional Averaging?**

Issues - CO₂ Mass Measurement

- ◆ **Stack Volumetric Flow Issues**
 - Reference method measurement
 - Flow monitor setup
- ◆ **Issues Related to Dilution
Extractive CEMS.**

Potential Flow Biases

- ◆ **Non-Axial Flow Exists**
- ◆ **Method 2 S-Type Probes are Insensitive to Orientation**
- ◆ **Wall Effects Are Real**
- ◆ **Pitot Tube Coefficient Bias**

Correct Approach to Flow Monitor Setup

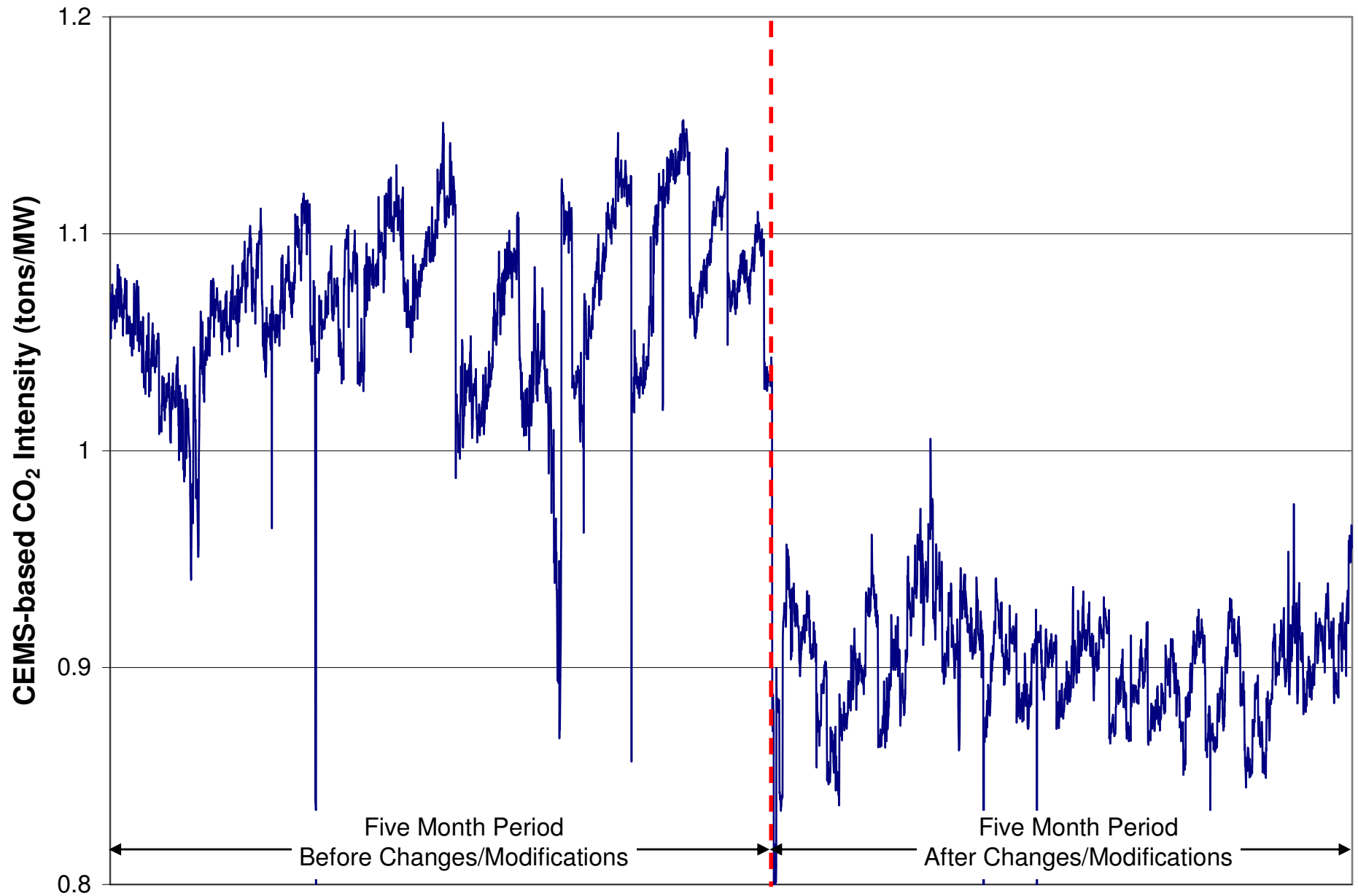
- ◆ **Flow Monitor Must Agree with RM to Meet Relative Accuracy Requirements.**
- ◆ **Thus, it is critical to use the proper reference methods to account for:**
 - **Non-axial flow (i.e., flow swirl)**
 - **Wall effects**
 - **Accurate pitot coefficients – insist on quality wind tunnel calibrations.**

Dilution Ratio Biases

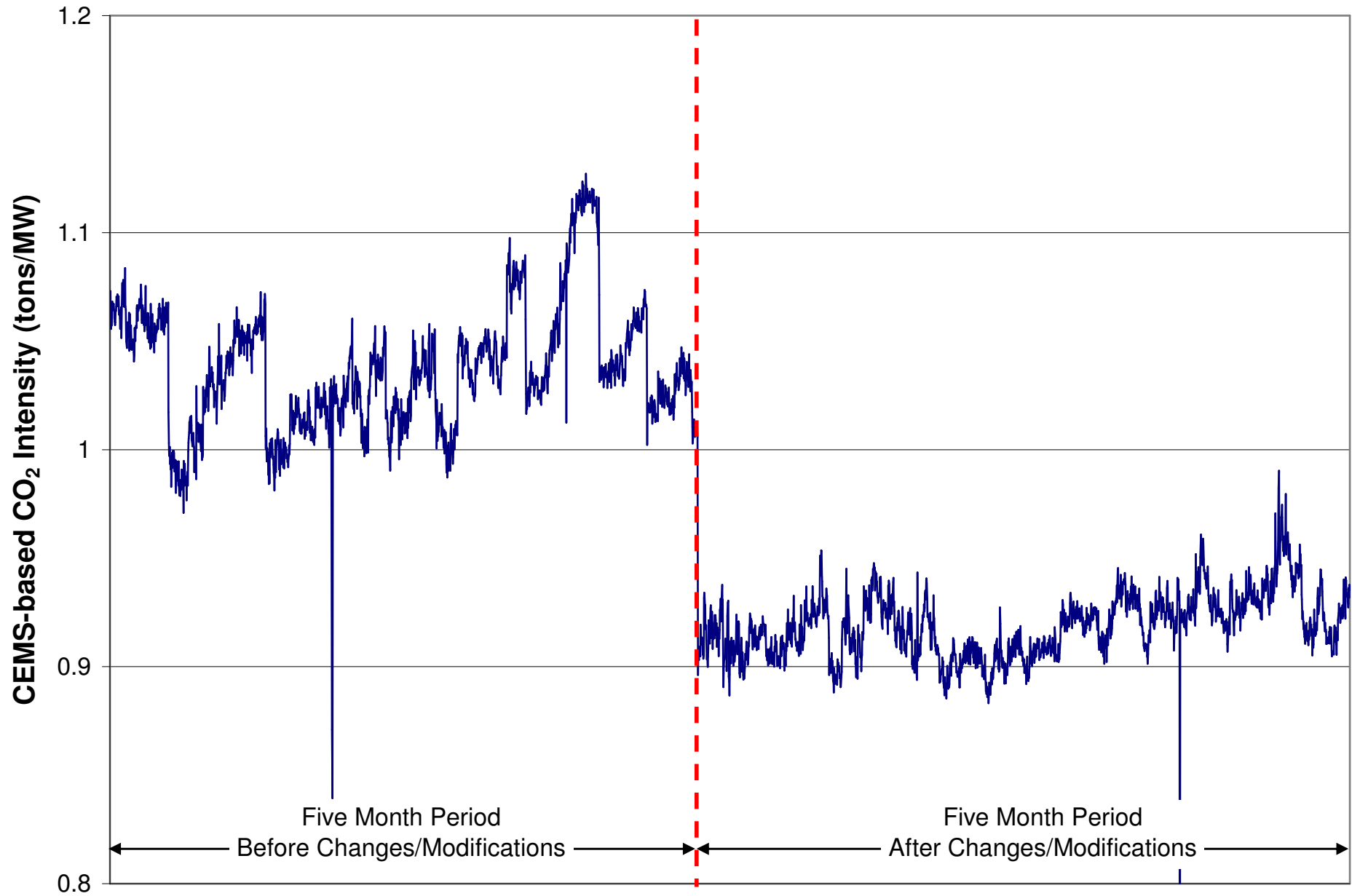
- ◆ **Most Coal-Fired Units are Equipped with Dilution-Based Sampling System.**
- ◆ **Dilution Ratio is Maintained by Critical Orifice.**
- ◆ **Assumed Constant but is Affected by Sonic Properties of the Gas:**
 - **Temperature & pressure**
 - **Molecular weight.**

Dilution Ratio Biases (Cont'd)

- ◆ **Change in Ambient Conditions Creates Measurement Uncertainty.**
- ◆ **Differences in Molecular Weight Create Biases.**
- ◆ **Dilution Ratio Algorithm Can Correct Molecular Weight Bias as well as Account for Temperature and Pressure Variations.**



Unit A Before & After Results



Conclusions

- ◆ **CO₂ Regulations are Coming; Fate Ultimately be Decided by the Courts.**
- ◆ **Realize Your Management is Going to Insist on Accurate CO₂ Measurement.**
- ◆ **We have Demonstrated that CEMS Accuracy Can be Optimized.**
- ◆ **Optimal Accuracy Requires Dedication.**

Questions

