Overview of a Strategy to Exempt Multiple Process Heaters from the "Boiler MACT" at a Large Oil and Gas Processing Facility

Barry Andrews, Antea Group

Oil&Gas ENVIRONMENTAL CONFERENCE



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Barry Andrews, P.E.

Senior Consultant

Antea USA, Inc.

Barry.Andrews@anteagroup.com

(970) 292-1047

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Summary of Presentation

Overview of Regulations Impacting Boilers/Process Heaters
Primer on Air Quality Regulations
Differences Between the Regulation of Major and Area Sources
Summary of Boiler MACT Rule and Requirements
Description of Oil and Gas Processing Facility
Sources that are Predominant Contributors of Hazardous Air Pollutants (HAPs)
Initial Inventory of Facility's HAPs Emissions
Evaluation of Strategies to Lower HAPs Emissions
Final Inventory of Facility's HAPs Emissions after Implementing Strategy
Regulatory Process to Obtain Approval to Become an Area Source of HAPs
Personal Thoughts Regarding Regulatory Compliance
Questions

Regulations that Potentially apply to Boilers/Process Heaters at Oil and Gas Processing Facilities

- NESHAPS for Industrial, Commercial, and Institutional Boilers and Process Heaters at Major Sources (Subpart DDDDD)
- NESHAPS for Industrial, Commercial, and Institutional Boilers at Area Sources (Subpart JJJJJJ)

NESHAPS – National Emissions Standards for Hazardous Air Pollutants

Three Types of Pollutants

1. Criteria Pollutants

   (National Ambient Air Quality Standards – NAAQS) Particulate Matter (PM_{10}, $PM_{2.5}$), Sulfur Dioxide, Nitrogen Dioxide, Carbon Monoxide, Ozone and Lead)

2. Hazardous Air Pollutants (HAPs)

   Designated List and other Air Toxics

   (Currently 187 listed HAPs)

3. Greenhouse Gases

   Carbon Dioxide, Methane, Others

   (Expressed as CO_2 Equivalents)

Types of Sources

- Major (New Source Review)
- Major (Title V Program) – Criteria and HAPs (MACT)
- Minor (New Source Review)
- Synthetic Minor
- True Minor (Title V)
- Area Source (GACT)

MACT – Maximum Achievable Control Technology

GACT – Generally Available Control Technology

Title V and Air Toxics Programs

Applicability Triggered by:

- Potential to Emit (PTE) of a Criteria Pollutant ≥ 100 Tons Per Year (tpy)
- PTE of an Individual HAP ≥ 10 tpy
- PTE of all HAPs Combined ≥ 25 tpy

Source Designation (Facility Based)

Considered Major if:

- PTE of an Individual HAP ≥ 10 tpy
- PTE of all HAPs Combined ≥ 25 tpy

Considered Minor (area source) if:

Neither of the criteria shown above is met

Potential to Emit

Process Heater

- Design Heat Input Rate – 50 MMBtu/hr
- Fuel Consumption – Natural Gas
- Natural Gas Heating Value – 1,020 Btu/scf
- AP-42 Emissions Factor for Hexane (External combustion)
  - 1.8 lb/MMscf

PTE for Hexane = [(50 MMbtu/hr)/(1,020 Btu/scf)] (1.8 lb/MMscf) = 0.088 lb/hr. At 8,760 hours operation per year equivalent to 0.39 tons per year.

How are Major HAPs Sources Regulated?

- 18 Different Subcategories Depending on Fuel and Combustion Design (e.g., coal/oil/biomass/gas 2 (other) gas fluidized bed/pulverized coal) for existing units
- All Subcategories except gas 1 fired units must meet Specified Emissions Limits for HCl and Mercury
- Depending on Subcategory there are Specific Emissions Limits for:
  - CO and Filterable PM or Total Selected Metals (TSM)

  TSM – Sum of arsenic, beryllium, cadmium, chromium, lead, manganese, nickel and selenium

- Process Heaters are Included as a Regulated Source

How are Minor HAPs (Area) Sources Regulated?

- For Existing Boilers Emissions Limits only apply to coal-fired units. Work Practice Standards and other Measures Required for other types of Fuel Combustion
- There are no Boiler Subcategories
- Emissions Limits Established for:
  - CO (Surrogate for Polycyclic Organic Matter)
  - Mercury
- Process Heaters are Exempt

Definitions (§63.7575)

- **Boiler** means an enclosed device using controlled flame combustion and having the primary purpose of recovering thermal energy in the form of steam or hot water.
- **Process heater** means a device use to transfer heat indirectly to a process material or to a heat transfer material for use in a process unit, instead of generating steam.
  - Process heaters are devices in which the combustion gases do not come into direct contact with process materials.

Source: EPA November 21, 2013 Webinar

Affected Source (§63.7490)

- The collection of all existing boilers and process heaters within a subcategory
- Each new or reconstructed boiler or process heater
  - new if construction commence after **June 4, 2010**
  - reconstructed if you meet the reconstruction criteria and reconstruction commence after June 4, 2010
- A boiler or process heater is existing if it is not new or reconstructed.

Source: EPA November 21, 2013 Webinar

What Units Are NOT Covered? (§63.7491)

- Any boiler or process heater that is part of the affected source subject to another NESHAP.
- Any boiler or process heater listed as an affected source in any standard established under Section 129 of the Clean Air Act (CAA).
- **Synthetic area sources – major sources with existing boilers and process heaters that become area sources prior to January 31, 2016**

Source: EPA November 21, 2013 Webinar

Conflict with Once In, Always In Provision?

EPA Guidance from May 1995 states:

"facilities that are major sources of HAPs on the "first compliance date" are required to comply **permanently** with the MACT standard to ensure that maximum achievable reductions in toxic emissions are achieved and maintained."

However, the same guidance document states:

"facilities may switch to area source status at any time until the "first compliance date" of the standard."

Note: Limits ensuring that actual and potential emissions are below major source thresholds must be federally enforceable.

Compliance Requirements for Existing Units

- **Existing large boilers and process heaters (≥ 10mm/BTU)**
  - **•Clean gas**
    - Annual tune-up
    - 1-time energy assessment
  - **•Process gas that is not "clean" gas**
    - The same requirements listed above plus numeric emission limits for 4 pollutants Hg, PM (or TSM), HCl, CO
- **Existing small boilers and process heaters (<10mm/BTU)**
  - **•Gas (all types)**
    - Tune-up every other year
    - 1-time energy assessment

Source: EPA November 21, 2013 Webinar

Tune-up Requirement (§63.7540(a)(10))

- *As applicable, **inspect the burner**, and clean or replace any components as necessary;*
- ***Inspect the flame pattern**, as applicable, and adjust the burner as necessary to optimize the flame pattern.*
- ***Inspect the system controlling the air-to-fuel ratio,** as applicable, and ensure that it is correctly calibrated and functioning properly;*
- ***Optimize emissions of CO** consistent with manufacturer's specifications, and with any NOx requirement to which the unit is subject.*

Source: EPA November 21, 2013 Webinar

Tune-up Requirement (Cont.)

- **Measure** CO and oxygen before and after the adjustments are made.
  - May use a portable CO analyzer;
- **Maintain** on-site and submit, if requested, a report containing:
  - The CO and oxygen measured at high fire or typical operating load before and after the adjustments;
  - Description of any corrective actions taken; and
  - Type and amount of fuel used over the prior 12 months.

Source: EPA November 21, 2013 Webinar

Tune-up Frequency Requirements

- **Tune-ups every 5 years for:**
  - Boilers and process heaters with oxygen trim systems
  - Limited-use boilers and process heaters with a federally enforceable annual average capacity factor of ≤ 10%
  - Gas-fired and light oil-fired boilers and process heaters with heat input capacity ≤ 5 MMBtu/hr
- **Tune-ups every 2 years for:**
  - Boilers and process heaters with heat input capacity <10 MMBtu/hr
- **Tune-ups every year**
  - Boilers and process heaters with heat input capacity ≥10 MMBtu/hr

Source: EPA November 21, 2013 Webinar

Energy Assessment

- Must have a one-time energy assessment performed by a qualified energy assessor.
- Applicable only to affected existing boilers and process heaters.

What Also Qualifies?

- An energy assessment completed after January 1, 2008.
- An energy management program compatible with ISO 50001 that includes the affected units.

Source: EPA November 21, 2013 Webinar

Energy Assessment Must Include:

(1) Visual inspection of the boiler and PH system,

(2) Evaluation of operating characteristics of affected boiler and PH systems and energy use systems,

(3) An inventory of major energy use systems,

(4) A review of available architectural/engineering plans, operation/maintenance procedures/logs, and fuel usage,

(5) A list of major energy conservation measures that are within the facility's control,

(6) A list of the energy savings potential of the energy conservation measures identified, and

(7) A comprehensive report detailing the ways to improve efficiency, the cost of specific improvements, benefits, and the time frame for recouping those investments.

Source: EPA November 21, 2013 Webinar

Energy Assessment Duration Requirements

Combined Annual Heat Input Capacity in Trillion Btu/yr (TBtu/yr), of ……	Length of Energy Assessment not to Exceed……	Energy Assessment will include this percent of energy output from energy use systems
Less than 0.3	8 on-site technical labor hours	At least 50%
0.3 to 1.0	24 on-site technical labor hours	At least 33%
Greater than 1.0	24 on-site technical labor hours for first 1.0 TBtu/yr, and 8 hour for each additional TBtu/yr, but not to exceed 160 hours.	At least 20%

Source: EPA November 21, 2013 Webinar

Energy Assessment Definitions

- Energy use system
  - located on site,
  - use energy provided by the affected boiler or process heater,
  - may be segmented by production area or energy use area (e.g., product X manufacturing area; Building Z).

Source: EPA November 21, 2013 Webinar

Energy Assessment Definitions (cont.)

- Qualified energy assessor
  - Person, or persons, that demonstrated capabilities to evaluate energy savings opportunities for steam generation and major energy use systems.
  - Has background, experience, and recognized abilities to perform the assessment activities, data analysis, and report preparation.
  - Familiar with the particular steam, process heating, and end-use systems.

Source: EPA November 21, 2013 Webinar

Summary of Oil and Gas Processing Facility

- Inlet Capacities
  - 30,000 Barrels of Oil per day
  - 90 MMSCF Gas per day (includes nitrogen)
  - 240,000 Barrels of Produced Water per day
- Predominant Contributors of HAPs
  - Two 15,300 HP Gas Fired Turbines (Water Injection)
  - Six 1,000 HP Gas Fired Recompressors (4SRB)
  - Other Turbines and Engines (H_2O Injection and Rec.)
  - Two New Fractionation Units (Natural Gasoline)

Affected Sources at the Facility

- Two 56.7 MMBtu/hr Process Heaters
- Two 28.4 MMBtu/hr Stabilizer Bottom Heaters
- One 55.7 MMBtu/hr Hot Oil Heater

Note: Based on operating 8,760 hours per year each the process heaters heat input would combine for a total of 1.98 TBtu per year.

Initial Potential to Emit of Individual HAPs

HAP	PTE (tons/year)	Sources
Acetaldehyde	4.50	Uncontrolled Engines
Acrolein	4.49	Uncontrolled Engines
Benzene	1.12	Uncontrolled Engines
Formaldehyde	18.1	Uncontrolled Engines and Turbines
Hexane	1.74	Process Heaters
Methanol	1.43	Uncontrolled Engines
Note: Total HAPs combined equivalent to 35.75 tons per year when including all sources (glycol dehydration, flaring, fugitives, etc.)		

Initial Strategy to Focus on Formaldehyde Reduction

- Uncontrolled 5,000 HP 2SLB engine responsible for 10.11 tons per year of total (AP-42 Factors)
- Uncontrolled 2,500 HP 2SLB engine which was inoperable but still included in current Title V permit responsible for 5.06 tons per year (AP-42 Factors)

Solution

- Add Catalytic Control to 5,000 HP engine
- Remove 2,500 HP engine from Title V permit

Note: Abandoned approach to control 5,000 HP engine after price of oil took significant drop.

Subsequent Strategy – Quantify all HAPs Emissions

- Conduct EPA Reference Method 323 Test for Formaldehyde Emissions from 5,000 HP Engine.
- Sample inlet and outlet concentrations (catalytic converter) of acrolein, and acetaldehyde from the 1,000 HP recompressor engine that showed the lowest level of control of formaldehyde based on most recent Subpart ZZZZ stack tests.
- Conduct sampling of sales oil which now contained natural gasoline as an input from the two fractionation units.

Result of Subsequent Strategy

- Formaldehyde emissions from 5,000 HP engine based on testing equivalent to a potential to emit of 0.55 tons per year (worst of three 1-hour runs).
- Determined ratio of Acrolein to Acetaldehyde from 5,000 HP engine significantly less than that portrayed by AP-42 factors
- Determined that Acetaldehyde controlled by catalytic converter at an efficiency level of 48 percent and Acrolein controlled by an efficiency level of 88 percent from the 1,000 HP recompressor that had the lowest removal efficiency of formaldehyde.
- Concluded that HAPs emissions from sales oil increased to a level of 10.53 tons per year as a result of adding fractionation units.

Final Potential to Emit of Individual HAPs

HAP	PTE (tons/year)	Sources
Acetaldehyde	1.31	Uncontrolled Engines
Acrolein	0.70	Uncontrolled Engines
BTEX	7.57	Sales Oil
Formaldehyde	1.75	Uncontrolled Engines and Turbines
Hexane	5.65	Process Heaters/Sales Oil
Methanol	1.21	Uncontrolled Engines

Note: Above values do not include any emissions from 2,500 HP engine. Total HAPs combined equivalent to 22.24 tons per year when including all sources (glycol dehydration, flaring, fugitives, etc.)

Summary of Regulatory Interaction

- First discussed the concept of looking at reducing HAPs to below the major source threshold levels with regulatory agency on October 28, 2014.
- In each subsequent meeting included this initiative as an agenda item.
- Used the new information that was obtained from stack testing and sampling/analysis to compute PTE of HAPs in Title V renewal application that was submitted in June 2015.
- Currently as requested by agency, have submitted an air construction permit application to establish facility as an area source of HAPs.
- Fully expect to have federally enforceable air permit from regulatory agency by the **January 31, 2016** deadline.

Personal Thoughts

- In today's regulatory climate the best approach to compliance is to first focus on any and all strategies that are available to exempt sources from new requirements.
- The downside to compliance is that it is becoming more difficult to understand exactly what is needed to demonstrate compliance and the resources that are needed for such demonstrations are often in short supply.
- We are seeing a trend for compliance becoming more onerous for a given source/facility once it has been determined that a particular regulation is applicable.
- It is apparent that federally developed regulations are going through more iterations than what we have seen in the past.
- Very important for companies to carefully review and comment on newly proposed regulations (compare to cooking pasta).

Questions

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Conference participants are eligible for up to 13 contact hours 1.3 CEUs. Forms will be available after lunch on Wednesday at the registration are.

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