Complying with the Greenhouse Gas Reporting Rule for Natural Gas Transmission and Storage

Sponsored by:

Pipeline Research Council International, Inc.

The INGAA Foundation, Inc.

Presented by:

Innovative Environmental Solutions, Inc.

Houston TX
December 2010

Welcome to the PRCI and INGAA Foundation GHG MRR Workshop

- EPA adopted the Greenhouse Gas (GHG) Mandatory Reporting Rule (MRR) on October 30, 2009
  - » Published as Title 40, Part 98 of the Code of Federal Regulations (40 CFR 98)
  - » For natural gas systems, includes reporting requirements for *combustion* sources (Subpart C) and general provisions (Subpart A)
- On November 29, 2010, EPA amended 40 CFR 98 to add Subpart W
  - » Subpart W: Reporting for Petroleum and Natural Gas Systems
- Operators must now decipher and implement these new federal rules

Table of Contents by Topic (1 of 2)

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Introduction and Objectives

- The workshop is intended to:
  - » Identify the content of the new rules
  - » Provide implementation materials that will facilitate operator compliance – i.e., Compliance Checklists
  - » Provide a forum for operators to discuss compliance issues and approaches
  - » Begin to develop a list of issues for dialogue with EPA
    - – Identify confusing or erroneous rule text
    - – "Parking lot" list of issues will be developed
- Workshop will focus on requirements for natural gas transmission and underground storage
  - » Subpart W requirements will be the primary focus
  - » Subpart C combustion emissions also addressed

Workshop Binder

- Workshop Binder: *8 tabs* provide support material
  1. Workshop Slides
  2. Example Compliance Checklists (for Subparts C and A)
     - – Subpart W checklists will be available in January 2011
  3. Acronyms, links to EPA on-line support documents, material, list of rule docket documents
  4. Subpart W Final Rule
  5. Subparts A and C (2009 Final Rule and 2010 amendments)
     - – e-CFR version that integrates 2009 rule and 2010 amendments
  6. Recent revisions to Subparts A and C (Signed 11/24/10)
  7. INGAA Comments on Subpart W Proposal (Exec. Summary)
  8. Placeholder for implementation and compliance questions that will be developed from the workshops

Workshop Nomenclature
Terminology for Workshop discussion

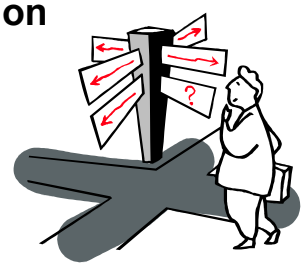
- Focus on two Subpart W segments: Natural gas transmission and underground storage (T&S)
- Subpart C = Combustion reporting
- Subpart W = Reporting of vented and fugitive emissions from T&S segments
  - » "Fugitive emissions" = "Equipment leaks"
- Subpart A = General provisions for reporting
- CO_2e = CO_2 equivalent emissions
- "tonnes" = metric tons (2204.6 lbs)
- Heating value references are bases on "high heating value" (HHV); EPA convention for emission factors
- Acronym table is provided in Tab 3

Workshop Agenda

- Background on Mandatory Reporting Rule
- Applicability – Is my facility subject?
- Combustion emissions reporting (due 3/31/2011) and Compliance Checklists (examples for Subpart C)
- Defining Subpart W industry segments and source list
- Review requirements for each source type for T&S segments
  - » Estimation methods, measurement requirements, and records
- Discussion session and re-visit issues identified (end of Day 1)
- Monitoring, measurement and instrumentation requirements
- Best Available Monitoring Methods
- Reporting and Recordkeeping requirements (facility-level)
- Operator Panel
- Final discussion and issue summary

Greenhouse Gas Mandatory Reporting Rule Background

- Rule history and evolution



GHG Mandatory Reporting Rule Background

- Fiscal Year 2008 Consolidated Appropriations Act including funding for GHG emissions reporting
  - » Funding for EPA to develop a rule to "…require *mandatory reporting* of GHG emissions above *appropriate thresholds* in *all sectors* of the economy of the United States."
  - » Joint explanatory statement (non-binding, but relevant guidance)
    - – Rule must include "upstream production and downstream sources" as EPA "deems it appropriate."
- Federal mandatory reporting rule proposed in April 2009
- Final GHG Mandatory Reporting Rule (MRR) published in Federal Register on October 30, 2009
  - » Stationary sources, fossil fuel suppliers, and industrial GHG suppliers addressed in Title 40, Part 98 of the CFR (40 CFR 98)
- Through MRR, EPA will acquire information to inform future policy decisions (e.g., GHG control rules)

GHG Mandatory Reporting Rule Background

- For natural gas T&S, 2009 *proposed* rule included combustion, fugitive, and vented emissions
  - » Subpart C: General Stationary Fuel Combustion Sources
    - – CO_2, CH_4, and N_2O from combustion
  - » Subpart W: Oil & Natural Gas Systems (excluded from Final Rule)
    - – CH_4 and CO_2 from fugitive and vented natural gas emissions
    - – Extensive comments received on Subpart W
    - – EPA did not include Subpart W in October 2009 Final Rule
  - » Subpart A General Provisions also apply
    - – Definitions, reporting, recordkeeping, monitoring QA/QC, etc.
- October 2009 GHG MRR Final Rule requires reporting of 2010 *combustion* GHG emissions by March 31, 2011
  - » There have been several 2010 revisions to "clean up" Final Rule
- Subpart W re-proposed on April 12, 2010

GHG MRR Background: CO_2e Reporting Convention

- Emissions reported as "CO_2 equivalent" (CO_2e) based on "Global Warming Potential" (GWP)
- GWP normalizes the radiative forcing effect of different gases relative to CO_2 (the reference gas) on a mass basis
  - » GWPs specified in MRR Subpart A, Table A-1
  - » GWPs include: 21 for methane, 310 for N_2O, 1 for CO_2
  - » Values based on Second Assessment Report (SAR) from U.N. Intergovernmental Panel on Climate Change (IPCC)
    - – GWPs are updated in subsequent IPCC reports, but SAR values are referenced in the Kyoto Protocol and are the common reporting convention

GHG MRR Background: Emissions Threshold

- T&S facilities with annual CO_2e emissions ≥25,000 metric tons (or tonnes) are subject; based on actual emissions
  - » For 2010, based on combustion emissions for T&S facilities
  - » Use Subpart C emissions factors (EFs) to determine combustion emissions of CO_2, CH_4 and N_2O
    - – CH_4 emission factor more typical for turbine or boiler than reciprocating engine
    - – Cumulative emission factor equivalent to 53.07 kg CO_2e/MMBtu
      - Or, ~1.0 lb CO_2e / bhp-hr at 8500 Btu/hp-hr (HHV based)
- Facility size and utilization for 25,000 tonnes annually from natural gas combustion
  - » Annual tonnes = HP x BSFC / $1x10^6$ x annual hrs x 53.07 / 1000
  - » e.g., 6500 hp at 8250 Btu/hp-hr (HHV-based) and 100% utilization

GHG Mandatory Reporting Rule Background

- EPA has issued several revisions in 2010 that affect Subparts A and C
- October 28, 2010 Final Rule
  - » Minor technical corrections and clarifications for Subpart A (e.g., definitions); No Subpart C changes
  - » This revision included in rule provided in Tab 5 of the Workshop Binder
- August 11, 2010 Proposed Rule
  - » Final rule was signed on November 24, 2010 but has not been published in the Federal Register
  - » Pre-publication revisions for Subparts A and C in Tab 7
  - » Recent rule has not been closely reviewed, but several highlights follow

Subpart A and C Revisions
Rule Signed November 24, 2010

Revisions to Subpart A include:

- **Natural gas definition (improvement from proposed rule):**
  - » **Natural gas means a naturally occurring mixture of hydrocarbon and non-hydrocarbon gases found in geologic formations beneath the earth's surface, of which the principal constituent is methane. Natural gas may be field quality or pipeline quality.**
- **Missing Data recordkeeping no longer requires: (1) records of event duration, or (2) actions taken to prevent or minimize future occurrences**
- **Correcting Reports for "substantive errors" – EPA clarified that minor errors (e.g., facility information) may not warrant correction but ANY emissions reporting error must be corrected**

Subpart A and C Revisions
Rule Signed November 24, 2010

Revisions to Subpart A include:

- **Meter calibration accuracy of 5% only applies to meters specified by a Subpart (e.g., *required* metering for Tier 3)**
  - » **Other meter calibration, QA/QC, and related criteria also clarified or revised**
  - » **Other measurement devices must meet accuracy requirements in relevant subpart, industry standards, or manufacturer's specs**

Revisions to Subpart C include:

- **Tier 3 estimates can use actual HHV to calculate CO_2 and N_2O emissions (rather than requiring default value)**
- **Remove "pipeline" term when referring to natural gas**

GHG MRR: Subpart W Background

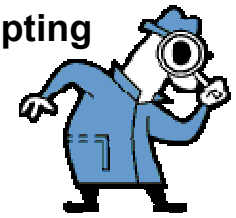
- **Subpart W: Petroleum and Natural Gas Systems**
  - **Final Rule Published in Federal Register at 75 FR 74458 – 74515 On November 30, 2010**
    - **December 30, 2010 effective date (only 30 days after publication because this is not considered a "major rule" where annual costs exceed $100 million)**
  - **Requires reporting of 2011 emissions by March 31, 2012**
  - **Includes all natural gas industry segments from the wellhead to the burner tip**
    - **Sources to report depend on industry segment**
  - **25,000 tonnes applicability based on combustion, vented, and fugitive (i.e., equipment leak) emissions**

GHG MRR Background: December 8, 2010 EPA Webinar

- **EPA has scheduled three webinars on Subpart W**
- **First webinar was held December 8**
  - **High level overview of MRR, Subpart W and Subpart C**
  - **Insight was not provided into Final Rule complexities or inconsistencies that this Workshop will discuss**
- **Additional Subpart W webinar planned for December 16**
- **January 5, 2011 webinar will focus on Subpart W requirements for upstream production segments**

Applicability: §98.2 Who must report?

- Is my facility subject to Subpart C?
- Is my facility subject to Subpart W?
- Streamlined tools and EPA implementation support
- "Once in" and criteria for exempting subject facility from reporting



Applicability

- Is the facility subject to the GHG MRR?
- Applicability section will discuss:
  - » Facility definition
  - » Transmission and storage segment definitions
  - » Applicability criteria – GHG emissions and sources
  - » Determination for 2010 reporting (Subpart C)
  - » Determination for 2011 reporting (Subparts C and W)
  - » "Methods" for determining applicability
  - » EPA guidance on screening methods
    - – Subpart C, other rule examples, and status for Subpart W
  - » EPA feedback from December 8 webinar

2010 and 2011 Reporting

- October 2009 Final Rule did not include Subpart W
- Facility applicability for 2010:
  - » 25,000 tonne CO_2e threshold based only on combustion emissions, and
  - » The aggregate maximum rated heat input capacity of the stationary combustion units at the facility is ≥ 30 mmBtu/hr
- For 2011, Subpart W vented gas emissions & equipment leaks will be included when determining applicability
  - » 2011 reporting year to include vented and fugitive gas
  - » Emissions include CH_4, CO_2, and N_2O if flared
  - » 2011 emissions reported by 3/31/12

Facility Based Applicability Definitions

- Emitter facility applicability is in §98.2 (a)(1) – (3)
  - » (a)(1) lists affected source categories that must report and do *not* include an emissions threshold (e.g., refineries)
  - » For T&S, (a)(3) applies for 2010 (combustion only) and (a)(2) applies for 2011+ (Subpart W added to Table A-4)
  - » "Supplier" applicability is defined in paragraph (a)(4)
- Facility definition for most segments, including T&S:
  - » Physical property, plant, building, structure, source, or stationary equipment;
  - » On contiguous or adjacent properties;
  - » In actual physical contact or separated solely by public roadway or other public right of way; and
  - » Under common ownership or common control `

Practical Aspects for Determining T&S "Facility"

- **Definition of the source category**

  § 98.230(a)(4) *Onshore natural gas transmission compression* means any stationary combination of compressors that move natural gas at elevated pressure from production fields or natural gas processing facilities in transmission pipelines to natural gas distribution pipelines or into storage. In addition, transmission compressor station may include equipment for liquids separation, natural gas dehydration, and tanks for the storage of water and hydrocarbon liquids.

Practical Aspects for Determining T&S "Facility"

- **§ 98.230(a)(5) *Underground natural gas storage* means subsurface storage, including depleted gas or oil reservoirs and salt dome caverns that store natural gas that has been transferred from its original location for the primary purpose of load balancing (the process of equalizing the receipt and delivery of natural gas); natural gas underground storage processes and operations (including compression, dehydration and flow measurement, and excluding transmission pipelines); and all the wellheads connected to the compression units located at the facility that inject and recover natural gas into and from the underground reservoirs.**
- **Inside fenceline (except storage wellheads)**
- **Does not include pipelines, M&R stations, etc.**
- **Does not include gathering lines and boosting stations**

EPA Applicability Flowchart

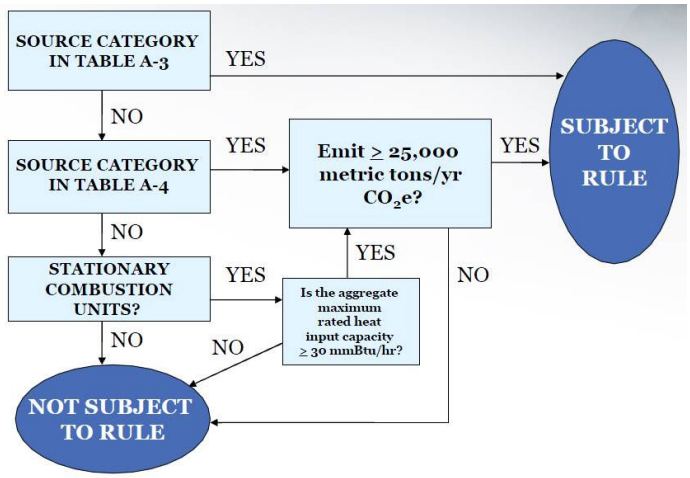


Table A–4 to Subpart A: Source Category List for §98.2(a)(2)

Applicable in 2010 and Future Years

- Ferroalloy Production (subpart K)
- Glass Production (subpart N)
- Hydrogen Production (subpart P)
- Iron and Steel Production (subpart Q)
- Lead Production (subpart R)
- Pulp and Paper Manufacturing (subpart AA)
- Zinc Production (subpart GG)

Applicable in 2011 and Future Years

- Magnesium Production (subpart T)
- Industrial Wastewater Treatment (subpart II)
- Industrial Waste Landfills (subpart TT)
- **PETROLEUM AND NATURAL SYSTEMS (subpart W)**
- Electronics Production
- Fluorinated GHG Production

Stationary Fuel Combustion Devices

Applicability for 2010 Reporting Only Considers Combustion

- **Determine if the facility emits 25,000 metric tons or more of CO_2e (For the 2010 inventory, 25,000 tonnes applicability is only based on combustion devices)**
  - **Boilers**
  - **Stationary Internal Combustion Engines**
  - **Process Heaters**
  - **Combustion Turbines**
  - **Other Stationary Fuel Combustion Equipment****
- **Examples provided in "introductory" slides**

** Excludes portable equipment, emergency generators, emergency equipment, agricultural irrigation pumps, hazardous waste combusters (except for co-fired fossil fuels), and flares. *However, if vented emissions (e.g., from blowdowns or transmission condensate tanks) are flared, then reported emissions use the flare criteria in §98.233(n).* **Flares are not included in 2010**

Applicability Threshold

- **Comparison to the 25,000 metric ton CO_2e per year emission threshold**
  - **Calculate the annual <u>actual</u> emissions of CO_2, CH_4, N_2O in metric tons from all applicable source categories**
  - **Sum the emissions estimates for each GHG and calculate metric tons of CO_2e (apply GWP multiplier)**
  - **Natural gas composite emission factor (considering all three GHGs) = 53.07 kg CO_2e / MMBtu**
- **Facility may include multiple source categories**
- **If rule applies to any source category, report emissions for all source categories**

Subpart W Applicability Challenges

- EPA Subpart W screening tool/method is <u>not</u> available
- *Addition* of vented and fugitive sources to combustion CO_2e for determining applicability with the 25,000 metric ton threshold for 2011 inventory adds complexity and uncertainty
- EF based applicability determination considerations?
  - » Estimates clearly indicate > 25,000 tonnes CO_2e; inventory required
  - » If ample margin exists using conservative estimates, no further investigation required?
  - » If GHG emissions margin relative to 25,000 tonne CO_2e threshold is marginal, measurements may be required?

Applicability: T&S Fugitive & Vented Sources

- EF or Engineering Estimates or …Measure (CO_2 and CH_4)
  - » Reciprocating compressor rod packing venting
  - » Centrifugal compressor venting
  - » Transmission storage tanks (transmission only)
  - » Blowdown vent stacks (transmission only)
- "Snapshot-in-time" single measurement may not be representative of source emissions
- Component counts needed in advance of estimates
- Emission factor based calculation (CO_2 and CH_4)
  - » Natural gas pneumatic device venting
  - » Equipment leaks from valves, connectors, open ended lines, pressure relief valves, and meters

Applicability Determination
Operator Discretion and Documenting Determination

- Approach to defining emissions, considering margin, and quantifying emissions to confirm "non-reporting" status depends on company "risk" tolerance
  - » EPA "tools" may not provide a "safe harbor"
  - » Decision will reside with the operator
- Assumptions and conservatism used in assessing proximity to threshold should be clearly documented (i.e., basis for <25k tonnes)
  - » Maintain files of estimates and measurements used for the applicability determination
  - » Document any confirming measurements

"Once In" Criteria and Future Exemptions for Subject Facilities

- Once a facility is subject, if emissions are subsequently reduced below 25,000 tonnes, reporting requirements apply until specific criteria are met:
  - » Reported emissions are less than 25,000 metric tons CO_2e for 5 consecutive years [§98.2(i)(1)]
  - » Reported emissions are less than 15,000 metric tons CO_2e for 3 consecutive years [§98.2(i)(2)]
  - » Facility operations have changed such that all applicable GHG-emitting processes and operations listed in Subpart C and Subpart W cease to operate. [§98.2(i)(3)]

EPA Example

Facility Description	Required to Report?	Explanation
A natural gas transmission compression station emits 24,000 metric tons of CO_2e/year from stationary combustion and 2,000 metric tons of CO_2e/year from equipment leaks and vented sources.	2012 (collect data in '11) Yes for subpart W Yes for subpart C	This facility must **report** under subpart C and subpart W in **2012** because combined emissions from stationary combustion and equipment leaks and vents are 25,000 metric tons/yr CO_2e or more.

Applicability Screening Tool

- **INGAA comments on Subpart W requested a screening tool and provided a recommendation**
  - » **EPA has stated a subpart W screening tool is in development, but not yet available**
- **For combustion, calculator available at:**

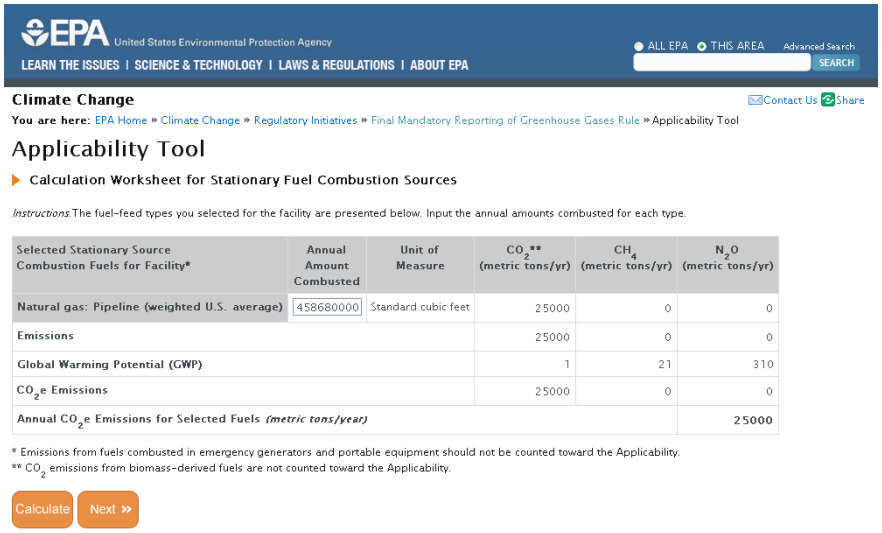
http://www.epa.gov/climatechange/emissions/GHG-calculator/index.html

- **EPA Subpart W calculator will supposedly:**
  - » **Use easy-to-access information**
  - » **Address all industry segments except LNG import/export terminals**
  - » **Provide conservatively high emission estimates**

Combustion Screening Tool

- Calculate facility emissions from stationary fuel combustion sources
- Select fuel type (select all that apply)
- Input the annual amounts combusted for each fuel type
  - » Natural gas input as standard cubic feet per year
  - » ~458.7 MMscf/year = 25,000 tonnes (CO_2 only)
  - » ~5,000 – 7,000 hp (combustion only) could trigger reporting (based on 24/7 operation)
  - » Since natural gas combustion calculation is straightforward (e.g., composite emission factor), this tool has limited utility for gas-fired sources

Combustion Screening Tool



Questions?

GHG MRR – Subpart C
General Stationary Fuel Combustion Sources

- Pollutants
- Estimation Tiers
- Tier 1 and Tier 2 details
- Other requirements (aggregation, common fuel lines, etc.)
- 2010 emissions reporting
- Example compliance checklists

GHG Reporting Rule: Subpart C Overview

- Subpart C: emissions from stationary combustion units
  - All fuels: Coal, NGLs, LPGs, NG, Biomass, Municipal Waste
- Subpart A (General Provisions) for reporting, etc. apply
- Reporting of CO_2, CH_4, and N_2O emissions required
  - Reporting at "unit level"
  - Aggregation allowed for NG-fired units <250 MMBtu/hr
- Four methodologies ("tiers") for emission estimates
  - Tier 1: "Company records" used to determine fuel supply, default HHV and CO_2 emission factors
  - Tier 2: "Company records" to determine fuel supply, direct measurement of HHV, and default CO_2 emission factors
  - Tier 3: Direct measurement of fuel supply & carbon content
  - Tier 4: Continuous Emissions Monitoring System (CEMS)

Definition of Company Records (§98.6)

Company records means, in reference to the amount of fuel consumed by a stationary combustion unit (or by a group of such units), a complete record of the methods used, the measurements made, and the calculations performed to quantify fuel usage. Company records may include, but are not limited to, direct measurements of fuel consumption by gravimetric or volumetric means, tank drop measurements, and calculated values of fuel usage obtained by measuring auxiliary parameters such as steam generation or unit operating hours. Fuel billing records obtained from the fuel supplier qualify as company records.

Subpart C: "Tiered Reporting" Overview

- Natural gas-fired units
  - » Higher tiers (more rigor) can be used if desired
  - » Tier 1 is acceptable if HHV is not measured for units ≤ 250 MMBtu
  - » Tier 2 required if measured HHV is available for units of any size and for units > 250 MMBtu
  - » Tier 3 may be used for NG-fired units of any size
    - – Tier 3 is not required if the use of Tier 1 or Tier 2 is allowed
  - » Tier 4 not applicable (unless an electric utility w/ CEMS)
- Methodology for reporting CH_4 / N_2O
  - » Default emission factors provided in the Rule must be used (discussed briefly in introductory slides)

Subpart C: NG-Fired Units Tier 1

- Tier 1 applies for natural gas-fired units:
  - » With maximum rated heat input capacity ≤ 250 MMBtu/hr; and
  - » Fuel HHV not determined (by operator or supplier) on a semi-annual or more frequent basis

  OR
  - » Where the annual NG consumption in therms is obtained from fuel billing records – regardless of unit size & fuel HHV analysis

Subpart C: NG-Fired Units Tier 1

$$GHGi\left(\frac{\text{tonne}}{\text{yr}}\right) = Fuel\left(\frac{\text{scf}}{\text{yr}}\right) * HHV\left(\frac{\text{MMBtu}}{\text{scf}}\right) * EFi\left(\frac{\text{kg GHGi}}{\text{MMBtu}}\right) * 0.001\left(\frac{\text{tonne}}{\text{kg}}\right)$$

- **GHG_i – GHG (CH_4, CO_2, N_2O) emissions**
- **Fuel – Annual fuel use from Company Records**
- **HHV – Default higher heating value.**
- **EF_i – Default GHG (CH_4, CO_2, N_2O) emission factor**
- **0.001 – conversion factor for kg to tonne**

Subpart C: NG-Fired Units Tier 2

- **Tier 2 may be used for natural gas-fired units of any rated heat input capacity**
- **Tier 2 must be used (rather than Tier 1) for natural gas-fired units:**
  - » **With maximum rated heat input capacity >250 MMBtu/hr**

  AND/OR
  - » **Fuel HHV is determined (by operator or supplier) on a semi-annual or more frequent basis.**
  - » **Provided annual NG consumption in therms not available**

Subpart C: NG-Fired Units Tier 2

$$\mathbf{G}\mathrm{HGi}\left(\frac{\mathrm{tonne}}{\mathrm{yr}}\right) = \mathbf{F}\mathrm{uel}\left(\frac{\mathrm{scf}}{\mathrm{yr}}\right) * \mathrm{HHV}\left(\frac{\mathrm{MMBtu}}{\mathrm{scf}}\right) * \mathrm{EFi}\left(\frac{\mathrm{kg\,GHGi}}{\mathrm{MMBtu}}\right) * 0.001\left(\frac{\mathrm{tonne}}{\mathrm{kg}}\right)$$

- **GHG_i – GHG (CH_4, CO_2, N_2O) emissions**
- **Fuel – Annual fuel use from Company Records**
- **HHV – Measured higher heating value**
- **EF_i – Default GHG (CH_4, CO_2, N_2O) emission factor**
- **0.001 – conversion factor**

Subpart C: NG-Fired Units Tier 3

- **Tier 3 may be used for units of any rated capacity**
- **Tier 3 is not required if Tier 1 or Tier 2 use is allowed**
- **Tier 3 shall be used for units that fire fuels other than distillate fuel oil or NG and have a max rated heat input capacity > 250 MMBtu/hr.**
  - » **Annual fuel use directly measured by fuel flow meters calibrated according to §98.3(i)**
  - » **Fuel carbon content and MW determined by sampling and analysis (by operator or supplier) on a semi-annual or more frequent basis**
- **GHG emissions determined from:**
  - » **Annual fuel use measured by fuel flow meter (scf/yr)**
  - » **Measured or default HHV (MMBtu/scf)**
  - » **CO_2 "emission factor" from fuel analysis (kg/MMBtu)**
  - » **Default CH_4 and N_2O emission factors (kg/MMBtu)**

Subpart C Inflexibility for Combustion N_2O and CH_4

- Rule *requires* use of default emission factors for fuels listed in Table C-1, which includes NG
  - » Emission factors do not account for source type and are relatively low for natural gas-fired reciprocating engines
    - – Analogous to Tier 2 emission factors in the INGAA GHG Guidelines
  - » Final Rule does not provide the option for more refined emission factors or source-specific data
  - » Reduces accuracy
    - – For some sources (e.g., methane from reciprocating engines), the CO_2e emissions may not be trivial and will be under-estimated – and relatively significant compared to some other sources mandated by EPA in Subpart W

Summary of Aggregation Approaches for Reporting

Subpart C includes aggregation related provisions:

- "Aggregation of Units" option
- Common-fuel-supply option;
- Common-pipeline-configuration option; or

Aggregation of Units for Reporting

- Per §98.36(c)(1), reporting is allowed for combined GHG emissions for a group of units – in lieu of individual unit reporting if the following applies:
  - » Facility contains multiple units and, each has a maximum rated heat input capacity ≤ 250 MMBtu/hr.
  - » Unit level emission calculations summed for group total
  - » Tier 4 is not required/used for any of the units
  - » Same tier is used for common fuels combusted
- Report includes Group ID number, the number of units in the group, and cumulative maximum rated heat input capacity of the group (MMBtu/hr)

Common-Fuel-Supply (CFS) Reporting

- CFS applies where a common liquid or gaseous fuel supply is shared between one or more large combustion units (e.g., boilers or turbines); and small sources (e.g., space heaters, hot water heaters)
- CFS reporting may be used when:
  - » The total annual quantity of fuel combusted in the units sharing the fuel supply is measured, in the facility or at the facility "gate", using a fuel flow meter, billing meter, or tank drop measurements
  - » At least 95% of the annual shared fuel is combusted in the large combustion unit(s), and remainder in the small units
  - » Reporting option is documented in the Monitoring Plan
  - » Tier 4 is not required/used for any of the units

Common-Fuel-Supply (CFS) Reporting

- Applies to all natural gas-fired stationary combustion equipment – Tier 1 vs. Tier 2 criteria apply
- Simplify reporting by attributing all of the GHG emissions from the shared fuel combustion to the large unit(s)

Common-Pipeline-Configuration (CPC) Reporting

- CPC applies where two or more liquid- or gas-fired stationary units combust fuel from a common supply line or pipe, and the total amount of fuel combusted is accurately measured using a fuel flow meter; and
  - » Any measured fuel diverted for other purposes is accounted for by company records
  - » Reporting option is documented in the Monitoring Plan
  - » Tier 4 is not required/used for any of the units
- Applies to all NG-fired stationary combustion equipment – Tier 1 vs. Tier 2 criteria apply
- Simplify reporting by combining GHG emissions from the units served by the common supply line

Subpart A General Provisions: Requirements for 2010 GHG Reporting

- General list of requirements (details on facility-level reporting and recordkeeping tomorrow)
  - » Annual report and revisions
  - » Monitoring plan
    - – Flow meter calibrations (as appropriate)
    - – GC operation and QA/QC
  - » Recordkeeping (calibrations, activity data, etc.)
  - » Verification – certification statements
    - – Authorization and responsibilities of the designated representative
  - » Use of best available monitoring methods
- Overview slides follow – details on Subpart C reporting are included in Compliance Checklists
  - » e.g., data elements required for Tier 1 or Tier 2 reporting

2010 "Abbreviated" Report

- "Abbreviated report" is allowed for 2010 combustion emissions (not allowed for 2011), and content includes:
  - » Facility name and physical street address
  - » Year and months covered by the report; Date of submittal
  - » Facility-level rather than unit-level reporting – i.e., total facility GHG emissions aggregated for all stationary fuel combustion units calculated according to any method specified in Subpart C, §98.33(a) and expressed in metric tons of CO_2, CH_4, N_2O, and CO_2e
  - » Facility operating / process data used for the GHG calculations
  - » Certification statement
- Best Available Monitoring Methods were allowed from January 1 through March 31, 2010

2010 Subpart C Reporting Overview

- Annual facility report submitted no later than March 31, 2011
  - » Submitted electronically consistent with §98.4 requirements
- Certificate of representation (for a designated representative) submitted at least 60 days before the initial report deadline
- Complete certificate of representation includes:
  - » Identification of the facility
  - » Name, organization, and contact information for the designated representative and any alternate designated representative
  - » A list of the facility owners and operators
  - » Required certification statements

GHG Monitoring Plan

- Complete by March 31, 2010 / 2011 for Subpart C / C & W
- Primary elements include:
  - » Identification of positions of responsibility (i.e., job titles) for emissions data collection
  - » Explanation of the processes and methods used to collect the data for GHG emission calculations
    - – Fuel use by "Company Records" and fuel HHV
    - – Subpart W emission sources
  - » Description of the procedures and methods used for QA, maintenance, and repair of all CMS, flow meters, and other instrumentation that provide GHG reporting data
    - – Calibration of fuel meters and/or equipment to measure "auxiliary parameters" used to calculate fuel use by "Company Records."
    - – Calibration of vent gas flow meters, hi-volume samplers, etc
  - » Monitoring Plan may reference existing corporate documents (e.g., SOPs, etc.) as long as required elements are included

Example Checklists

- Compliance checklists will be developed for Subparts C and W, as well as relevant Subpart A requirements
- Example Subpart C and Subpart A checklists available in Workshop Binder Tab 2
- Schedule precluded Subpart W checklists for December workshop
  - » Checklists will be available in January

Draft Checklists

- Draft Checklists in Workshop Binder include:
  - » Monitoring Plan: Natural gas T&S facilities Monitoring Plan
  - » Annual Report: Natural gas T&S facilities Annual Report
  - » Subpart C Tier 1, NG-fired Combustion Unit: Natural gas-fired stationary combustion equipment, Subpart C Tier 1 unit-level reporting
  - » Subpart C Tier 2, NG-fired Combustion Unit: Natural gas-fired stationary combustion equipment, Subpart C Tier 2 unit-level reporting
  - » Subpart C Tier 1, NG-fired Combustion CPC: Natural gas-fired stationary combustion equipment, Subpart C Tier 1 common pipeline configuration reporting
  - » Subpart C Tier 2, NG-fired Combustion CPC: Natural gas-fired stationary combustion equipment, Subpart C Tier 2 common pipeline configuration reporting

GHG MRR – Subpart W
Petroleum and Natural Gas Systems

Day 1 Topics for Subpart W:

- Industry Segments
- Source Types for Transmission and Storage
- Requirements by Source Type
- Discussion of "parking lot" issues

Subpart W Final Rule

- Subpart W published in the Federal Register on November 30, 2010
  - » Rule effective date is December 30, 2010
  - » Report 2011 emissions by March 31, 2012
  - » Includes revisions to Subpart A:
    - – New or revised definitions (see Notebook Tab 4)
    - – Table A-4 revised to include Petroleum and Natural Gas Systems source category
- §98.230(a) defines eight industry segments
- §98.232 defines source types that require reporting for each industry segment

Subpart W – Revisit Applicability

- For transmission and storage, applicability considers emissions from combustion and Subpart W sources
- §98.2 Who must report?

  (a)(2): *A facility that contains any source category that is listed in Table A–4 of this subpart and that emits 25,000 metric tons CO_2e or more per year in combined emissions from stationary fuel combustion units,… and all applicable source categories that are listed in Table A–3 and Table A–4 of this subpart.* For these facilities, the annual GHG report must cover stationary fuel combustion sources (subpart C of this part),… and all applicable source categories listed in Table A–3 and Table A–4 of this subpart.

Subpart W Industry Segments

- Subpart W eight industry segments cover industry from the wellhead to burner tip
  - Offshore petroleum and natural gas production
  - Onshore petroleum and natural gas production
  - Onshore natural gas processing
  - Onshore natural gas transmission compression
  - Underground natural gas storage
  - Liquefied natural gas (LNG) storage
  - LNG import and export equipment
  - Natural gas distribution
- "Facility" definition for onshore E&P (basin-based) and LDCs (company-based) will broadly cover these sectors

Subpart W Industry Segments

- **Transmission defined in §98.230(a)(4):**

  (4) *Onshore natural gas transmission compression.* Onshore natural gas transmission compression means any stationary combination of compressors that move natural gas at elevated pressure from production fields or natural gas processing facilities in transmission pipelines to natural gas distribution pipelines or into storage. In addition, transmission compressor station may include equipment for liquids separation, natural gas dehydration, and tanks for the storage of water and hydrocarbon liquids. Residue (sales) gas compression operated by natural gas processing facilities are included in the onshore natural gas processing segment and are excluded from this segment. This source category also does not include reporting of emissions from gathering lines and boosting stations—these sources are currently not covered by subpart W.

Subpart W Industry Segments

- **Underground storage defined in §98.230(a)(5):**

  (5) *Underground natural gas storage.* Underground natural gas storage means subsurface storage, including depleted gas or oil reservoirs and salt dome caverns that store natural gas that has been transferred from its original location for the primary purpose of load balancing (the process of equalizing the receipt and delivery of natural gas); natural gas underground storage processes and operations (including compression, dehydration and flow measurement, and excluding transmission pipelines); and all the wellheads connected to the compression units located at the facility that inject and recover natural gas into and from the underground reservoirs.

Subpart W Emission Source Types

- For each industry segment, §98.332 identifies the source types that are included for reporting
  - » Number of source types vary by segment
    - – e.g., 20 for onshore production; 3 for LNG storage
  - » EPA intent is to capture at least 85% of the GHG emissions
- Emissions to report:
  - » For combustion, report CO_2, CH_4 and N_2O
  - » For vented and fugitive emissions, report CH_4 and CO_2
    - – Nomenclature change: In the Final Rule, EPA changed terminology and Subpart W now uses the term "equipment leaks" rather than "fugitive emissions"

Subpart W Emission Source Types

- § 98.232(e) identifies six source types for "onshore natural gas transmission compression" segment:
  - (1) Reciprocating compressor rod packing venting
  - (2) Centrifugal compressor venting
  - (3) Transmission storage tanks
  - (4) Blowdown vent stacks
  - (5) Natural gas pneumatic device venting
  - (6) [Reserved] *(Proposed rule segregated "high" and "low" bleed devices & had seven source types listed)*
  - (7) Equipment leaks from valves, connectors, open ended lines, pressure relief valves and meters

Subpart W Emission Source Types

- § 98.232(f) identifies four source types for "underground natural gas storage" segment:
  - (1) Reciprocating compressor rod packing venting
  - (2) Centrifugal compressor wet seal degassing venting
  - (3) Natural gas pneumatic device venting
  - (4) Reserved
  - (5) Equipment leaks from valves, connectors, open ended lines, pressure relief valves and meters

Subpart W Emission Source Types

- Source types have unique subsection in §98.233 that defines the GHG calculation methodology
  - » §98.233(a) – Natural gas pneumatic device venting
  - » §98.233(i) – Blowdown vent stacks
  - » §98.233(k) – Transmission storage tanks
  - » §98.233(o) – Centrifugal compressor venting
  - » §98.233(p) – Reciprocating compressor venting
  - » §98.233(q) – Leak detection & leaker emission factors
  - » §98.233(r) – Population count and emission factors
  - » Also, §98.233(n) for flare stack emissions applies in some cases
- Details by source type and method follow…

Questions?

…LUNCH!

Subpart W Requirements by Source Type

- **Methodologies, measurements, activity data, calculations, and records and reporting for each source type**

Subpart W Emission Source Types

- Source types / method for Transmission and Storage
  - §98.233(a) – Natural gas pneumatic device venting
  - §98.233(i) – Blowdown vent stacks
  - §98.233(k) – Transmission storage tanks
  - §98.233(o) – Centrifugal compressor venting
  - §98.233(p) – Reciprocating compressor venting
  - §98.233(q) – Leak detection & leaker emission factors
  - §98.233(r) – Population count and emission factors
- Additional §98.233 requirements are relevant
  - §98.233(n) – Flare stack emissions
  - §98.233(t) – Volumetric emissions
  - §98.233(u) – GHG volumetric emissions
  - §98.233(v) – GHG mass emissions

Subpart W Emission Source Types

- Unique §98.233 section(s) apply for each source type
  - Two sections for equipment leaks depending on whether "leaker" or "population" emission factors apply
- For each source type, information follows on:
  - Source definitions or descriptions
  - Methodology, including equations and emission factors
  - "Standards" that apply for measurement, monitoring, etc.
  - Source-specific records and reporting requirements
    - Facility-level records & reporting "roll-up" discussed later
  - Interpretive or unclear issues for GHG calculations
    - Audience participation is encouraged!
- Methods include emission factors (e.g., with component counts), measurement, monitoring / survey, and engineering estimates / calculations

Subpart W Emission Source Types

- Organization for discussing methods will follow §98.233 order, but also address more straightforward sources and topics first:
  - Pneumatic devices
  - Blowdown vent stack
  - Transmission storage tanks
  - Flaring
  - Conversion to STP and CO_2e mass emissions
  - Reciprocating compressors
  - Centrifugal compressors
  - Equipment leaks

Emission Estimation Methods Summary

Emission Source	Monitoring Method	Emission Quantification Method
Natural Gas Pneumatic Devices - Low (≤ 6cfh), High (>6 scfh) or intermittent bleed devices	Component Count for Low Bleed, High Bleed and Intermittent Bleed Devices	Population EF (scfh) x device count x 8,760 hr/yr (two different emission factors)
Blowdown Vent Stacks	Engineering Estimation for Compressors, ESD	Equipment specific EF (based on volume, T, P) x number of events
Condensate Tanks (Transmission)	Leak Detection & Direct Flow Measurement	For leaking tanks; measured emission rate x operating hours
Centrifugal Compressor Blowdown Valve Leaks, Unit Isolation Valve Leaks, and Wet Seal Oil Degassing Vent	Direct Measurement of Vented Gas Emissions in TWO Modes	Measured emission rate (or Emission Factor if mode not measured) x operating hrs (by operating mode)
Reciprocating Compressor Rod Packing Vents, Blowdown Valve Leak, and Unit Isolation Valve Leak	Direct Measurement of Vented Gas Emissions THREE Operating Modes: -Operating, Standby, pressurized, Not operating, depressurized	Measured emission rate (or Emission Factor if mode not measured) x operating hrs (by operating mode)
Equipment Leaks	Leak Detection to ID "Leakers" OR Component count (population)	Leaking components count x Leaker EF x operating hours OR, Population x component count x EF (storage wellheads)

Pneumatic Device GHG Emission Estimate

Pneumatic Devices

- Population emission factor applies for low bleed, high bleed, or intermittent bleed pneumatic devices
  - » Same emission factor applies for high bleed and intermittent pneumatic devices
  - » High bleed (> 6 scfh)
  - » Low bleed (≤ 6 scfh)
  - » This is a simplification from proposed rule, which required actual rates for high bleed devices
- For T&S, component count required in 2011 for each of the three device categories

Pneumatic Devices: Definitions

- ***High-bleed pneumatic devices*** **are automated, continuous bleed flow control devices powered by pressurized natural gas and used for maintaining a process condition such as liquid level, pressure, delta-pressure and temperature. Part of the gas power stream that is regulated by the process condition flows to a valve actuator controller where it vents continuously (bleeds) to the atmosphere at a rate in excess of 6 standard cubic feet per hour.**

Pneumatic Devices: Definitions

- ***Low-bleed pneumatic devices*** **mean automated flow control devices powered by pressurized natural gas and used for maintaining a process condition such as liquid level, pressure, delta-pressure and temperature. Part of the gas power stream that is regulated by the process condition flows to a valve actuator controller where it vents continuously (bleeds) to the atmosphere at a rate equal to or less than six standard cubic feet per hour.**

Pneumatic Devices: Definitions

- ***Intermittent bleed pneumatic devices*** **mean automated flow control devices powered by pressurized natural gas and used for maintaining a process condition such as liquid level, pressure, delta-pressure and temperature. These are snap-acting or throttling devices that discharge the full volume of the actuator intermittently when control action is necessary, but does not bleed continuously.**

Pneumatic Devices: Methodology

- **Population emission factor applies for low bleed, high bleed, or intermittent bleed pneumatic devices**
  - » **Same emission factor applies for high bleed and intermittent pneumatic devices**
  - » **High bleed (> 6 scfh)**
  - » **Low bleed (≤ 6 scfh)**
- **For T&S, component count required in 2011 and count must be updated every year**

Pneumatic Devices: Calculation and Reporting

- GHG_i annual emissions (mass) per Equation W-1 =

  Count x EPA EF (scf/device-hr) x CF x GHG_i x 8760 hrs
  - » CF = conversion factor = 0.000410 tonnes / scffor CH_4
    0.00005357 for CO_2
  - » Hourly emission factor and 8760 hrs/yr assumed
  - » GHG_i (CH_4 or CO_2 in natural gas) assumes "1" (i.e., equation assumes 100% CO_2 and 100% CH_4 in gas)
- Reporting requirements:
  - » Aggregate annual emissions of CO_2e (metric tons).
  - » Count of high-bleed devices
  - » Count of low-bleed devices
  - » Count of intermittent bleed devices

Pneumatic Devices: Emission Factors

- Comparison of T&S pneumatic device emission factors

Pneumatic Device Population Emission Factors (scf/hr-component)		
Device Type	PROPOSED RULE	FINAL RULE
Low Bleed Pneumatic	2.57	1.41
Intermittent Bleed Pneumatic	N/A	18.8
High Bleed Pneumatic	Rate per Vendor	18.8

Pneumatic Devices: Issues

- Challenges and issues
  - » Identification by device type & 2011 component count
    - – Device classification can depend on application and operating conditions (e.g., pressure and temperature)
    - – Some devices may be difficult to classify – e.g., not labeled with manufacturer name, model number, etc.
    - – Since device counts my category must be reported, what is the "risk" if devices are mis-categorized?
  - » Calculation over-estimates emissions by assuming that natural gas is composed of 100% CH_4 and CO_2
    - – e.g., natural gas with 90% CH_4 and typical (low) CO_2 over-estimates CO_2e emissions by about 25%

Blowdown Vent Stack Emission Estimate

Blowdown Vent: Definition and Methodology

- §98.6(a) definition:

  Blowdown vent stack **emissions mean natural gas and/or CO_2 released due to maintenance and/or blowdown operations including compressor blowdown and emergency shut-down (ESD) system testing.**
- §98.233(i) indicates emissions should be reported from depressurizing equipment to the atmosphere
  - » Based on "engineering estimate"
- Emissions that go to flare should follow the same calculation methodology to determine vent volume and use flare section to calculate emissions

Blowdown Vent: Methodology and Reporting

- Calculate the total volume of equipment and vessels between isolation valves, including volume of all piping, compressor cases or cylinders, manifolds, suction and discharge bottles or any other gas-containing volume
  - » Physical volume is "determined by engineering estimate based on best available data."
  - » Total physical volumes with less than 50 cubic feet between isolation valves for process vessels, piping, and equipment do not have to be reported
- Reporting is required for each unique physical volume:
  - » Total number of blowdowns for each equipment type
  - » Aggregate annual emission per equipment type

Blowdown Vent: Calculation and Issues

- Calculation using Equation W-14 for each relevant physical volume; basic approach:
  Annual number of events x Volume x Purge factor x Correction to address actual T and P
- Equation W-14 questions or issues:
  - » Assumes ALL events for a particular volume are at the same conditions (same T and P)
    - – Equation is not a summation of events, but rather a volume calculation times the number of annual events
  - » Assumes complete blowdown to atmospheric pressure (i.e., not based on "$P_{start} - P_{final}$")
  - » Equation does not indicate how to determine P_{actual} when event pressure varies throughout the year

Transmission Storage Tank GHG Emission Estimate

Transmission Storage Tanks: Emission Source and Methodology

- Per §98.233(k), emission source for condensate storage tanks is "compressor scrubber dump valve leakage"
- "Monitoring" is required to determine integrity of the dump valve seal, using one of two options:
  - » Once per year vent stack monitoring using optical gas imaging instrument, or
  - » Once per year monitoring of leakage through compressor scrubber dump valve(s) into the tank using an acoustic leak detection device
  - » NOTE: Leak detection methods and instrumentation will be discussed tomorrow
- If leakage, determine emissions and report emissions individually

Transmission Storage Tanks: Methodology

- For optical gas imaging, follow §98.234(a)(1) procedures
  - » If tank vapors from the vent stack are continuous for five minutes, then emissions must be quantified:
    - – Measure vent stack emissions using a meter following a consensus method or industry standard practice
    - – Annual emissions based on measured vent rate and 8760 hours
- For acoustic device, follow manufacturer procedures to determine through valve leakage
  - » If leak $\geq$3.1 SCFH is calculated, a leak is detected
  - » Emission based on calculated leak rate and 8760 hours
- If valve is repaired, then emissions are calculated from the start of year to the time of the repair
- Use gas composition when calculating emissions (i.e., differs from assumption for pneumatic devices)

Transmission Storage Tanks: Methodology when Flaring

- If tank vent emissions are flared, determine "uncontrolled" emissions via one of two options, and then refer to calculations for flare stacks [§98.233(n)]
- Tanks emissions determined via:
  - » Acoustic device method discussed previously, OR
  - » Methodology 1 for production storage tanks from §98.233(j)
    - – Calculation using software and requiring measurement of requisite model input parameters

Flaring GHG Emission Estimate

Flaring

- "Flare stack emissions" are not a listed emission source for T&S segments; HOWEVER,
  - » If vented emissions are flared (e.g., from centrifugal compressor wet seal oil degassing vents [§98.233(o)(9)] or transmission condensate tanks [§98.233(k)(4)]), then reported emissions use the flare criteria in §98.233(n)
- §98.232(j) states: "All applicable industry segments must report the CO_2, CH_4, and N_2O emissions from each flare."
  - » Unclear which flared sources are required to report
  - » Could imply that flared "reportable sources" are required to report post-flaring emissions; OR
  - » Could imply that any flared source in the segment is required to report

Flaring

- CO_2, CH_4 and N_2O emissions from a flare stack are calculated from flared gas volume and composition, flare efficiency, and emission factors
- Flared gas volume:
  - » If available, data from a continuous flow measurement device must be used; or
  - » Calculate flared gas volume using Subpart W emission source methodology: transmission storage tank venting, centrifugal compressor wet seal oil degassing venting, etc.

Flaring: §98.233(n)

- Flared gas composition (CO_2, CH_4, carbon content)
  - » If available, data from a continuous gas composition analyzer must be used; or
  - » Average composition from annual sampling and analysis
- Flare combustion efficiency (η)
  - » From manufacturer, or default of 98 percent
- CO_2 emissions calculated from NG composition (carbon and CO_2 content), volume of gas flared, and η (i.e., combustion equations with fuel carbon oxidized to CO_2)
- Methane (from uncombusted gas) calculated from NG methane mole fraction, volume of gas flared, & (1 - η)
- N_2O emissions calculated from emission factor, volume of gas flared, and gas HHV

Volumetric Emissions Conversion to STP and CO_2e Emissions

Volumetric Conversion to STP

$$\mathbf{Es,}i(\text{scf}) = \frac{\mathbf{Ea,}i(\text{acf}) * (459.67 + \text{Ts}(^{\circ}\text{F})) * \text{Pa}(\text{psia})}{(459.67 + \text{Ta}(^{\circ}\text{F})) * \text{Ps}(\text{psia})}$$

- § 98.233 (t)(1), (2): Equations W-33, W-34
- Es,i – volumetric (NG, GHG) emissions at STP
- Ea,i – volumetric (NG, GHG) emissions at actual T&P
- Ts – standard temperature (60°F or 68°F)
- Pa – actual pressure
- Ta – actual temperature
- Ps – standard pressure (14.7 psia)

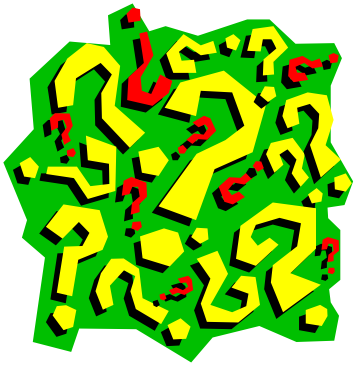
- Issues with industry standard (commonly 60 °F) and EPA standard (68 °F)?

Convert GHG Volumetric Emissions to CO_2e Mass Emissions

$$\mathbf{Mass}_i(\text{tonne CO2e}) = \text{Es},_i(\text{scf GHGi}) * \rho i\left(\frac{\text{kg GHGi}}{\text{scf}}\right) * \text{GWP}_i\left(\frac{\text{kg CO2e}}{\text{kg GHGi}}\right) * 0.001\left(\frac{\text{tonne}}{\text{kg}}\right)$$

- § 98.233 (v): Equation W-36
- Mass_i – emissions of GHG_i (e.g. CH_4, CO_2, N_2O) expressed as tonnes of CO_2e
- $\text{Es},_i$ – volumetric emissions of GHG_i
- ρ_i – density of GHG_i at standard T and P
- GWP_i – global warming potential of GHG_i
- 0.001 – kg to metric tons (tonne) conversion

Questions?



GHG Estimates from Compressors

Identifying Subpart W Requirements for Compressors…

- Review is complicated by "lack of clarity" or inconsistencies in rule text
- To identify requirements, IES attempted objective review of rule text:
  - » What does the rule text require?

  Versus:

  - » What do we think EPA wants?

  And

  - » What does EPA want?
  - » EPA's intent is relevant (to help sort this out)

Identifying Subpart W Requirements for Compressors

- What does EPA want?
  - » ???
- What do we think EPA wants?
  - » Measurement of individual vents in different modes
    - – Annual "as found" test (whatever the mode) on each compressor
    - – Measure "shutdown" mode at least every 3 years
  - » Emission estimates that consider time in each mode
  - » Estimate based on "measured" value when a measurement is completed in a particular year
  - » Estimate via company-specific EF for other modes
    - – EF based on all measurements in that mode by company
    - – As data compiled, EF is three year rolling average

Identifying Subpart W Requirements for Compressors

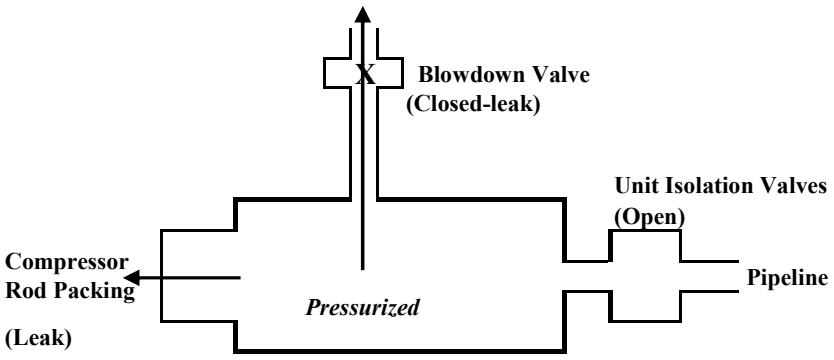
- HOWEVER, rule text (at best) is unclear
  - » Or, could be interpreted in different ways
- Following slides present equations and emission calculations for compressors
- Reporting requirements also presented
- Considering (1) equations, (2) rule text, and (3) reporting requirements is important because conflicts or unclear requirements arise when reconciling various criteria
- In the following slides, issues are identified in Red to facilitate discussion

Reciprocating Compressor GHG Emission Estimate

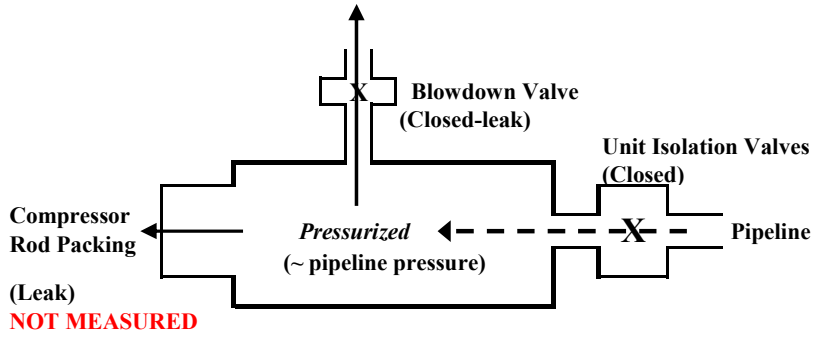
Reciprocating Compressors GHG Emissions Overview

- GHG emissions from reciprocating compressors determined for 3 vents during 3 compressor "modes":
  - » *Reciprocating rod packing vent* during Operating mode
  - » *Blowdown valve leakage vent* during Operating mode and Standby, Pressurized mode
  - » *Unit isolation valves leakage vent* during Not Operating, Depressurized mode
- Even though source is characterized a vent….emission is gas leak routed through vent (e.g. isolation valve leakage)
- Pressurized standby mode *Reciprocating rod packing vent* measurement omitted
  - » EPA GasSTAR data show this can be a large source

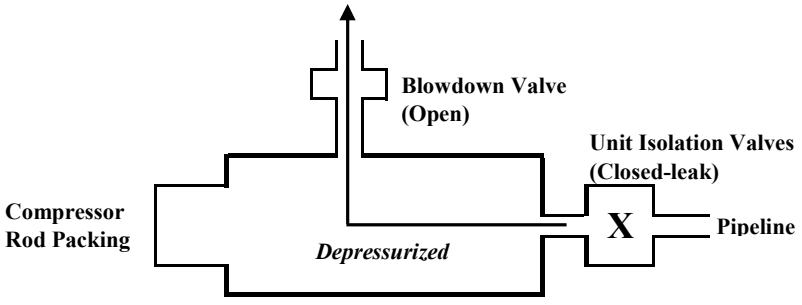
Reciprocating Compressors "Operating" Mode



Reciprocating Compressors
"Standby Pressurized" Mode



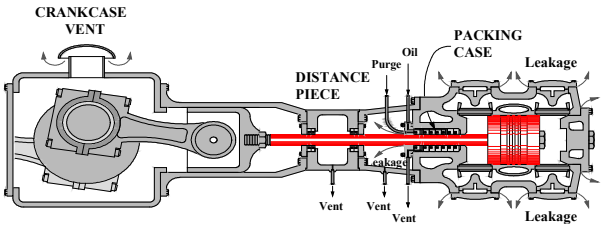
Reciprocating Compressors
"Not Operating, De-pressurized" Mode



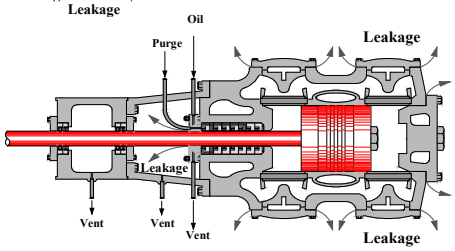
Reciprocating Compressor Vents

- **Vent lines not clearly defined**
  - » **§ 98.233(p)(5) provides insight into other possible sources of gas emissions: distance piece, compressor crank case breather cap or other vent with a closed distance piece**
  - » **These sources are not discussed elsewhere**
- **Preamble language (75 FR 74465) "If these sources are vented through a common manifold, you must measure each vent source separately."**
  - » **Rule text does not clarify this requirement**
  - » **Could require sample port installation and/or re-plumbed vent lines**

Reciprocating Compressor Vents



RECIPROCATING COMPRESSOR PACKING & VENT SYSTEM



EXPANDED VIEW OF THE COMPRESSOR HEAD

Reciprocating Compressors GHG Emission Measurements

- Annual GHG emissions determined from direct measurements and company-specific "Reporter" EFs
  - » Compressor emissions annually measured in "as found" mode
  - » Not Operating, Depressurized mode must be tested at least once in any three consecutive calendar years
    - – Not required if compressor is not operated, ***with blind flanges installed***, for three years (i.e., off-line and isolated)
- Measure emissions using either hi-volume sampler, calibrated bags, or temporary or permanent flow meter (e.g., vane anemometer or orifice meter)
  - » Isolation valve and blowdown valve leaks can be measured using an acoustic leak detection device

Reciprocating Compressors GHG Emission Calculations

$$\mathbf{Es}_{i,m}\left(\frac{\text{scf GHGi}}{\text{yr}}\right) = \text{MTm}\left(\frac{\text{scf NG}}{\text{hr}}\right) * \text{Tm}\left(\frac{\text{hrs}}{\text{yr}}\right) * \text{Mi}\left(\frac{\text{mole GHGi}}{\text{mole NG}}\right)$$

- Annual emissions for <u>"as found" tested mode</u> calculated using <u>direct measurement data</u> (Eqn. W-26)
  - » $Es_{i,m}$ – annual emissions of CH_4 or CO_2 in tested mode
  - » MTm – measured natural gas emissions in tested mode
  - » Tm – total annual hours the compressor was in tested mode
  - » Mi – mole fraction of CH_4 or CO_2 in the natural gas from facility gas composition
- Not clear how to adjust emissions if vented to a flare or VRU. Is MTm controlled or uncontrolled? Clarification is needed.
  - » Selective reference in §98.233(p)(8)(i) to applying VRU control when calculating emissions and calculating the emission factor
    - – (Note – analogous text for centrifugals is different)

Reciprocating Compressors GHG Emission Calculations

$$\mathbf{Es}_{,i,m}\left(\frac{\text{scf GHGi}}{\text{yr}}\right) = \text{EFm}\left(\frac{\text{scf NG}}{\text{hr}}\right) * \text{Tm}\left(\frac{\text{hrs}}{\text{yr}}\right) * \text{GHGi}\left(\frac{\text{mole GHGi}}{\text{mole NG}}\right)$$

- **Annual emissions for modes not tested that year calculated using "Reporter" EF (Eqn W-27)***
  - » **$E_{s,i,m}$– annual emissions of CH_4 or CO_2 in mode m**
  - » **EFm – reporter emission factor for mode m**
  - » **Tm – total annual hours the compressor was in mode m**
  - » **GHGi – default NG mole fractions: 1.0 for both CH_4 and CO_2**
    - – **Adjust emissions if vented to a flare or VRU**
- **Equation assumes 100% CH_4 *AND* 100% CO_2 in the natural gas**
  - » **Over-estimates emissions**
  - » **Not consistent with Eqn. W-26 that uses actual gas composition for calculating measured emissions**
  - » **Is this what EPA intended?**

***Eqn. W-27 sums emissions for all modes, but *reporting section* indicates basic equation used for single mode calculations**

Reciprocating Compressors GHG Emission Calculations

$$\text{EFm}\left(\frac{\text{scf NG}}{\text{hr}}\right) = \Sigma\left(\text{MTm}\left(\frac{\text{scf NG}}{\text{hr}}\right) \Big/ \text{COUNTm}\right)$$

- **"Reporter" EF used to calculate emissions from units in mode not testing during reporting year (Eqn W-28)**
  - » **EFm – reporter emission factor for mode m**
  - » **MTm – vent gas measurements from all reciprocating compressor vents in mode m**
    - – **e.g. for Operating mode, rod packing vent and blowdown vent emissions are measured**
  - » **COUNTm – total number of compressors measured in mode m**
    - – **Calculate emission factors annually**
    - – **Use all measurements from current year & two preceding years (i.e. rolling 3 year average)**
- **Interpretation is to use company-wide data (not facility-only) – but clarification is needed**

Reciprocating Compressors: Reporting

- Report emissions & supporting info for each unit:
  - » Annual throughput (MMcf)
  - » Total time (hrs) unit is in "Operating" mode
  - » Total time (hrs) unit is in "Standby, Pressurized" mode
  - » Total time (hrs) unit is in "Not Operating, Depressurized" mode
  - » Annual CH_4 emissions (scf/yr) and CO_2 emissions (scf/yr) from rod packing for "Operating" mode
    - – Compressors with measured emissions for reporting year (use Eqn. W-26)
    - – Compressors without measured emissions for reporting year (use Eqn. W-27 and Reporter EF)
  - » Not required to report "Reporter" EF (scf NG/hr) for "Operating mode" – required for other two modes

Reciprocating Compressors: Reporting

- Compressors without measured emissions for reporting year – rod packing (continued): Reporting requirements, and equation calculations and data are not aligned
  - » Equations (W-27, W-28) do not decouple Operating mode emissions for rod packing vent and blowdown valve vent EF (scf NG/yr) is mode composite
  - » Data are available to calculate all the required data to be reported; however, the required data cannot be calculated with the equations in the rule

Reciprocating Compressors: Reporting

- Report emissions & supporting info for <u>each</u> unit (continued):
  - » Reporter EF (scf/hr) for <u>blowdown vents</u> while compressors are in "Operating" and "Standby Pressurized" modes
  - » Annual CH_4 emissions (scf/yr) and CO_2 emissions (scf/yr) from blowdown vent for unit in "Operating" and "Standby Pressurized" modes

Reciprocating Compressors: Reporting

- Blowdown valve vent reporting (continued) – Confusing text regarding reporting.
- §98.236(c)(14)(ii) presents reporting requirements "For reciprocating compressors blowdown vents not manifold to rod packing vents…."
  - » Treatment of blowdown vents that are manifolded to rod packing vents?
  - » Based on preamble text [FR 74465]

    "If these sources are vented through a common manifold, you must measure each vent source separately."
  - » It would appear that all blowdown valve emissions must be measured whether manifolded or not.

Reciprocating Compressors: Reporting

- Blowdown valve vent reporting (continued): Report combined emissions (from both modes) or combined emissions (separate for each mode) from blowdown vent valve?
  - » §98.236(c)(14)(ii)(C) states "Report blowdown vent emissions when in operating and standby pressurized modes"
  - » This could be interpreted to mean "report blowdown vent emissions when in operating mode" and (separately) "report blowdown vent emissions when in standby pressurized mode" OR "report (combined) blowdown vent emissions from operating mode and standby pressurized mode"
  - » §98.233(p)(7)(i)(A) states "you must combine emissions from blowdown vents, measured in the operating and standby pressurized mode."
    - – Suggests that report combined emissions two modes is the correct interpretation

Reciprocating Compressors: Reporting

- Blowdown valve vent reporting (continued) - For mode tested during reporting year, use measured emissions or Reported EF (scf NG/hr)-calculated emissions for reporting and calculations?
  - » Inconsistent reporting requirements for vents
    - – Measured emissions reporting specified for rod packing vents
    - – Reporter-EF emissions reporting inferred for blowdown valve and isolation valve vents based on equations cited in reporting requirements.
  - » Question applies to reporting of both mode-specific emissions and rolled up emissions

Reciprocating Compressors: Reporting

- Blowdown valve vent reporting (continued)
- Reporter EF equations do not calculate combined Operating mode and Standby, Pressurized mode emissions from Blowdown vents
- Reporter EF equations do not calculate a blowdown vent Reporter EF
  - » Equations (W-27, W-28) do not decouple Operating mode emissions for rod packing vent and blowdown valve vent
  - » Equations do not combine blowdown valve vent emissions during two compressor modes
  - » Emissions data are available to calculate all the required data to be reported; however, the required data for reporting cannot be calculated with the rule equations

Reciprocating Compressors: Reporting

- Report emissions & supporting info for each unit:
  - » Reporter EF (scf/hr) for isolation valve leakage vents while compressors are in "Not Operating, Depressurized" modes
  - » Annual CH_4 emissions (scf/yr) and CO_2 emissions (scf/yr) from isolation valve leakage vent for unit in "Not Operating, Depressurized" mode
    - – For mode tested during reporting year, report measured emissions or EF-calculated emissions?
  - » Total annual CH_4 emissions (scf/yr) and CO_2 emissions (scf/yr) for each unit in all operating modes
    - – For mode tested during reporting year, use measured emissions or EF-calculated emissions for calculations?
      - Rule text interpretation implies EF used for all modes, but not clear this is EPA's intent

Reciprocating Compressors: Reporting

- **Facility emissions reporting requirement:**
  - » **Aggregated annual CO_2e emissions (metric tonnes/yr) for all reciprocating compressors in all operating modes [§98.236(a)]**
    - – **For mode tested during reporting year, use measured emissions or EF-calculated emissions for "Roll Up"?**

Reciprocating and Centrifugal Compressors: Recordkeeping

- **GHG emission calculations & methods (refer to Monitoring Plan)**
- **Best Available Monitoring Methods (BAMM) used for applicable data (hrs in each operating mode) collected 1/1/2011 to 6/30/2011**
- **BAMM used for applicable data (vent rates) collected 1/1/2011 to 12/31/2011, provided request to use BAMM is approved (as applicable)**
- **Approved BAMM used for other data and/or dates**
- **Results of each emission measurement**
- **Calibration reports for all measurement equipment**
- **Dates on which measurements were conducted**
- **Missing data procedures (as applicable)**
- **Calibration records for instruments used for vent gas rate measurements**
- **Maintenance records for instruments used for vent gas rate measurements**

Reciprocating Compressors: Other Questions and Issues

- Three vent lines not clearly defined
- It is unclear whether EPA intended mode-based emission factors or measurement based EFs
- Only one Reporter EF for reciprocating compressors for each mode, no subcategories based on pressure, size, service, manufacturer, model, maintenance, etc.
  - » No flexibility is provided to allow operator the option to segregate emission factors
  - » Lost opportunity to develop more accurate emission factors and understand parameters that impact emissions

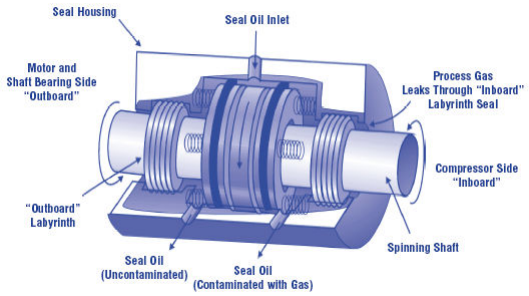
Centrifugal Compressor GHG Emission Estimate

Centrifugal Compressors
GHG Emissions Overview

- GHG emissions from centrifugal compressors determined for three ***vents*** during two compressor modes:
  - » ***Wet seal oil degassing vent*** during Operating mode for wet seal compressors;
  - » ***Blowdown valve leakage vent*** during Operating mode for wet seal and dry seal compressors; and
  - » ***Unit isolation valves leakage vent*** through open blowdown valve during Not Operating, Depressurized mode for wet seal and dry seal compressors.

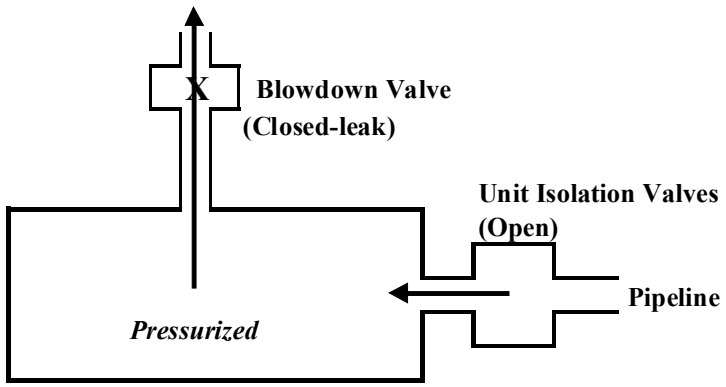
  - » For centrifugal compressors, emission measurements and reporting are not required for Standby, Pressurized mode

Centrifugal Compressors
Wet Seal Oil Degassing

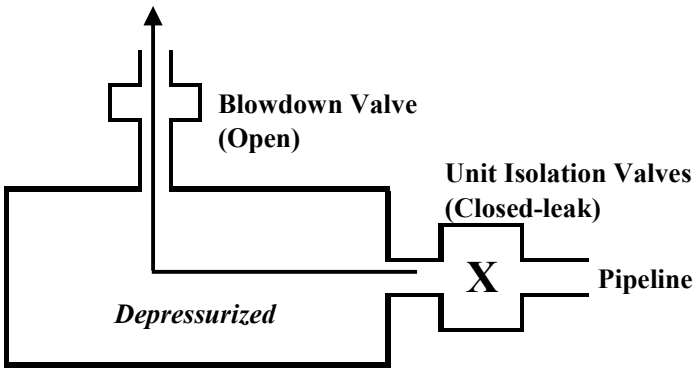


- High pressure seal oil is circulates between rings around the compressor shaft
- Gas absorbs in the oil on the inboard side
- Little gas leaks through the oil seal; however, seal oil degassing vents gas to atmosphere

Centrifugal Compressors Operating Mode



Centrifugal Compressors Not Operating, De-pressurized Mode



Centrifugal Compressors
GHG Emission Measurements

- **Annual GHG emissions determined from direct measurements and company-specific "Reporter" EFs**
  - » **Compressor emissions annually measured in "as found" mode**
  - » **Not Operating, Depressurized mode must be tested at least once in any three consecutive calendar years.**
    - – **Not required if compressor is not operated, *with blind flanges installed*, for three years (i.e., off-line and isolated)**
- **Measure emissions using hi-volume sampler, calibrated bags, or temporary or permanent flow meter**
  - » **Isolation valve leaks can be measured using an acoustic leak detection device**
  - » **"If these sources are vented through a common manifold, you must measure each vent source separately." (75 FR 74464)**

Centrifugal Compressors
GHG Emission Calculations

$$\mathbf{E}_{s,i,m}\left(\frac{\text{scf GHGi}}{\text{yr}}\right) = \text{MTm}\left(\frac{\text{scf NG}}{\text{hr}}\right) * \text{Tm}\left(\frac{\text{hrs}}{\text{yr}}\right) * \text{Mi}\left(\frac{\text{mole GHGi}}{\text{mole NG}}\right) * (1 - \text{Bm})$$

- **Annual emissions for <u>"as found" tested mode</u> calculated using <u>direct measurement data</u> (Eqn. W-22)**
  - » **$Es_{,i,m}$ – annual emissions of CH_4 or CO_2 in tested mode**
  - » **MTm – measured gas emissions in tested mode**
  - » **Tm – total annual hours the compressor was in tested mode**
  - » **Mi – mole fraction of CH_4 or CO_2 in the natural gas from facility gas composition**
  - » **Bm – fraction of time vent gas sent to VRU or fuel gas**

Centrifugal Compressors GHG Emission Calculations

$$\mathbf{Es}_{,i,m}\left(\frac{\text{scf GHGi}}{\text{yr}}\right) = \text{EFm}\left(\frac{\text{scf NG}}{\text{hr}}\right) * \text{Tm}\left(\frac{\text{hrs}}{\text{yr}}\right) * \text{GHGi}\left(\frac{\text{mole GHGi}}{\text{mole NG}}\right)$$

- **Annual emissions for <u>modes not tested during reporting year</u> calculated using "Reporter" EF (Eqn. W-23)**
  - » **Eqn. W-23 sums emissions for all modes, but reporting text indicates basic equation used for single mode calculations**
  - » **Es,i,m – annual emissions of CH_4 or CO_2 in mode m**
  - » **EFm – reporter emission factor for mode m**
  - » **Tm – total annual hours the compressor was in mode m**
  - » **GHGi – default NG mole fractions: 1.0 for both CH_4 and CO_2**
    - – **100% CH_4 AND 100% CO_2 in the natural gas?**
    - – **More accurate to use CH_4 and CO_2 from facility gas composition**
    - – **Calculate emissions of flared wet seal degassing vents emissions**
      - **Emission calculations do not consistently account for venting to a flare or VRU**

Centrifugal Compressors GHG Emission Calculations

- **Emission calculations do not consistently account for venting to a flare or VRU**
  - » **Eqn. W-22 for measured emissions includes control efficiency; fraction of operating time that the vent gas is sent to vapor recovery or fuel gas (i.e. "1-Bm" term)**
  - » **§98.233(o)(9) requires calculation of flare emissions for flared gas from wet seal oil degassing vents when the emissions are calculated using the Reporter EF (Eqn. W-23); however,**
    - – **Eqn. W-23 does not specifically account for degassing vents controlled by a VRU or for any controls (VRU or flare) from other vents**
      - **Emissions calculated/reported as uncontrolled**

Centrifugal Compressors GHG Emission Calculations

$$EFm\left(\frac{\text{scf NG}}{\text{hr}}\right) = \Sigma\left(MTm\left(\frac{\text{scf NG}}{\text{hr}}\right)\Big/ COUNTm\right)$$

- **"Reporter" EF used to calculate emissions from units in mode not testing during reporting year (Eqn. W-24)**
  - **EFm – reporter emission factor for mode m**
  - **MTm – vent gas measurements from all centrifugal compressor vents in mode m**
  - **COUNTm – total number of compressor measured in mode m**
    - **Calculate emission factors annually**
    - **Use all measurements from current year & two preceding years (i.e. rolling 3 year average)**
    - **Interpretation is to use company-wide data (not facility-only), but clarification is needed**

Centrifugal Compressors: Reporting

- **Wet seal oil degassing vent emissions. Report emissions and support info for each degassing vent:**
  - **Number of wet seals connected to degassing vent**
  - **Fraction of vent gas recovered for fuel or sales, or flared**
  - **Annual throughput (MMcf)**
  - **Type of meters used for measurements**
  - **Reporter EF (scf NG/hr) for wet seal oil degassing vents**
  - **Total time (hours) the compressor is operating**
  - **Annual CH_4 emissions (scf/yr) and CO_2 emissions (scf/yr)**
    - **Compressors with measured emissions for reporting year (Eqn. W-22)**
    - **Compressors without measured emissions for reporting year (use Eqn. W-23 and Reporter EF)**
    - **Equations (W-23, W-24) do not decouple Operating mode emissions for wet seal oil degassing vent and blowdown valve vent - EF (scf NG/yr) is mode composite**
    - **If vented gases are flared, calculate associated emissions using flare emissions methods. [§98.233(o)(9)]**

Centrifugal Compressors: Reporting

- **Blowdown vent emissions. Report for each centrifugal compressor (wet or dry seals):**
  - » **Total time (hours) the compressor is in operating mode**
  - » **Reporter EF (scf NG/hr) for blowdown vents.**
  - » **Annual CH_4 emissions (scf/yr) and CO_2 emissions (scf/yr) from blowdown vent when in "Operating" mode**
    - – **All emissions based on Reporter EF (Eqn. 23), no specification to report measured emissions**
    - – **Equations (W-23, W-24) do not decouple Operating mode emissions for wet seal oil degassing vent and blowdown valve vent – EF (scf NG/yr) is mode composite**
    - – **For mode tested during reporting year, report measured emissions or EF-calculated emissions?**

Centrifugal Compressors: Reporting

- **Blowdown vent emissions (continued) – For mode tested during reporting year, use measured emissions or Reported EF-calculated emissions for reporting and calculations?**
  - » **Inconsistent reporting requirements for vents**
    - – **Measured emissions reporting specified for wet seal oil degassing vents**
    - – **Reporter-EF emissions reporting inferred for blowdown valve and isolation valve vents based on equations cited in reporting requirements**
  - » **Question applies to reporting of both mode-specific emissions and rolled up emissions**

Centrifugal Compressors: Reporting

- Isolation valve leakage emissions: Report for each centrifugal compressor (wet or dry seals):
  - » Total time (hours) the compressor is in Not Operating, Depressurized mode
  - » Reporter EF (scf NG/hr) for isolation valve leakage vents while compressors are in Not Operating, Depressurized mode
  - » Annual CH_4 emissions (scf/yr) and CO_2 emissions (scf/yr) from isolation valve leakage vent when in "Not Operating, Depressurized" mode
    - – All emissions based on Reporter EF (Eqn. 23), no specification to report measured emissions.
    - – For mode tested during reporting year, report measured emissions or EF-calculated emissions?

Centrifugal Compressors: Reporting

- Total annual CH_4 emissions (scf/yr) and CO_2 emissions (scf/yr) for each unit in all operating modes
  - » For mode tested during reporting year, use measured emissions or EF-calculated emissions for calculations?
    - – Rule text interpretation implies EF used for all modes, but not clear this is EPA's intent
  - » §98.236(c)(13)(iv) only references Eqn. W-24 which calculates Reporter EF (scf NG/hr) for each mode.
    - – Interpret this to be a typo, Eqn. W-23 should be referenced and total CH_4 and CO_2 emissions should be reported

Centrifugal Compressors: Reporting

- **Facility emissions**
  - » Aggregated annual CO_2e emissions (metric tonnes/yr) for all centrifugal compressors in all operating modes. [§98.236(a)].
    - – For mode tested during reporting year, use measured emissions or EF-calculated emissions for "Roll Up"?

Centrifugal Compressors: Other Questions and Issues

- **Only one Reporter EF for Centrifugal compressors for each mode, no subcategories based on pressure, size, service, manufacturer, model, maintenance, etc.**
  - » No flexibility is provided to allow operator the option to segregate emission factors
  - » Lost opportunity to develop more accurate emission factors and understand parameters that impact emissions

Centrifugal Compressors: Questions and Issues

- Rule refers to three "modes" but testing is only conducted in two compressor modes: "Operating" and "Not Operating, Depressurized."
- It is unclear whether EPA intended mode-based emission factors or measurement based EFs
- For example, if *measurement* based EFs:
  - » Operating mode, blowdown valve leakage through the blowdown vent for both wet and dry seal compressors
  - » Operating mode, wet seal oil degassing vents
  - » Not operating, depressurized mode, unit isolation valve leakage through open blowdown vent, without blind flanges for both wet seal and dry seal compressors
  - » Versus two emission factors if mode-based

Compressor Vent Measurement Issues

Elevated Vents and Yard Suction / Discharge Piping Presents Safe Access Issues

Manlift Reach at Maximum Limit and Over High Pressure Gas Lines

Vent Measurement Complications

- Configuration and station systems preclude safe access to roofline reciprocating compressor vents and condensate tank vents in some cases
  - » Below grating
  - » Elevated above roof line
- Accessing vents could put technicians at risk should an emergency shutdown (i.e., blowdown) occur
- May violate corporate safety standards
- Manifolded vent line measurements not allowed
- Optical imaging can screen for leak but NOT measure it!
- BAMM discussion tomorrow – does BAMM (as currently devised) provide a reasonable means to address safety issues?

Equipment Leaks
GHG Emission Estimates

Equipment Leaks

- 98.233(r) – Population count and emission factors
- 98.233(q) – Leak detection and leaker emission factors
- Applies to emissions sources listed in § 98.232:
  - (e)(7) – For onshore natural gas transmission compression equipment leaks from valves, connectors, open ended lines, pressure relief valves, and meters
  - (f)(5) – For underground natural gas storage equipment leaks from valves, connectors, OELs, PRVs, and meters
- Stream greater than 10 weight percent CH_4 plus CO_2
- Tubing systems ≤ ½ inch diameter are exempt
- Use the methods described in § 98.234(a) to conduct leak detection survey for equipment leaks (Methods discussed in more detail tomorrow)

Component Counts

- Leaker emission factors for T&S
  - Requires annual leak detection survey to identify leaking components
  - Requires count of leaking components by component type
  - Since based on "leakers" from annual survey, counts will change every year
- Storage wellhead: Population based emission factors requires population count by component type in 2011
- Component counting requires proper expertise to identify component type (and service)

Leak Detection Methods Overview

- Perform a leak detection survey using one of the three following methods:
  - » Use an optical gas imaging instrument (40 CFR part 60, subpart A, § 60.18(i)(1) and (2) of the *Alternative work practice for monitoring equipment leaks)*
  - » Use an infrared laser beam illuminated instrument
  - » Use Method 21 with 10,000 ppmv leak threshold
- Through-valve leakage
  - » Acoustic leak detection device
- Soap solution and acoustical methods (for other than through valve leakage) not permitted without BAMM

Emission Factors for Fugitive Components

- Table W-3 – Transmission leaker EF's segmented into:
  - » Compressor components
  - » Non-compressor components
- Table W-4 – Storage leaker EF's:
  - » Storage station
- Table W-4 – Storage population EF's:
  - » Storage wellheads

- If only one leak survey is conducted in the calendar year, assume that all leaks emit for the entire year
  - » If multiple *complete* leak surveys are conducted, assume that each leak that is found has been emitting since the last survey; or since the beginning of the calendar year
- Calculate emissions using Equation W–30

Transmission Equipment Leaks:
Emission Factors and Component Types

Leaker Emission Factors (scf/hr-component)			
Emission Source	PROPOSED RULE	FINAL RULE	
	All Components	Compressor Components	Non-compressor Components
Connector	2.7	5.68	5.80
Block Valve	10.4		
Control Valve	3.4		
Regulator	9.8		
Compressor Blowdown Valve	543.5	N/A	N/A
Control, Block or Regulator Valve		15.07	6.52
Pressure Relief Valve	37.2	40.27	2.04
Orifice Meter	14.3		
Other Meter	0.1		
Meter		19.63	2.98
Open Ended Line	21.5	17.54	11.44

Storage Equipment Leaks:
Emission Factors and Component Types

STORAGE STATION LEAKER Emission Factors (scf/hr-component)		
Emission Source	PROPOSED RULE	FINAL RULE
Connector	0.96	5.68
Block Valve	2.02	
Control Valve	3.94	
Regulator	1.03	
Compressor Blowdown Valve	66.15	N/A
Control, Block or Regulator Valve		15.07
Pressure Relief Valve	19.80	40.27
Orifice Meter	0.46	
Other Meter	0.01	
Meter		19.63
Open Ended Line	6.01	17.54
STORAGE WELLHEAD POPULATION Emission Factors (scf/hr-component)		
Connector	0.01	0.01
Valve	0.10	0.10
Pressure Relief Valve	0.17	0.17
Open Ended Line	0.03	0.03

Equipment Leaks: Reporting
Leaker Emission Factors

- Equipment leaks found by leak surveys report:
  - » Total count of leaks found in each complete survey
    - – Listed by date of survey and type of leak source:
      - Transmission valves, connectors, OELs, PRVs, and meters in compression service
      - Transmission valves, connectors, OELs, PRVs, and meters in non-compression service
      - Storage valves, connectors, OELs, PRVs, and meters
  - » CH_4 default concentration of 100% and CO_2 default concentration of 1.1%
  - » CH_4 (scf/yr) and CO_2 (scf/yr) emissions collectively by equipment type (i.e., leak source type)
  - » Aggregated annual CO_2e emissions (metric tonnes per year) by equipment type (i.e., leak source type)

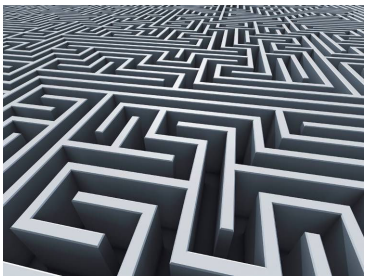
Equipment Leaks: Reporting
Population Emission Factors

- Equipment leaks calculated using *population* emission factors report:
  - » Total count of each leak source:
    - – Storage wellhead valves, connectors, PRVs, and OELs
  - » CH_4 (scf/yr) and CO_2 (scf/yr) emissions collectively by equipment type (i.e. leak source type).
    - – Based on CH_4 default concentration of 100% and CO_2 default concentration of 1.1%
  - » Aggregated annual CO_2e emissions (metric tonnes per year) by equipment type (i.e., leak source type)

Day 1 – Discussion and Parking Lot Issues

Day 2: Recap of Day 1

- Questions?
- Discussion of applicability, source types, and related requirements?
- Follow-up to day 1 discussion session?



Subpart W (Day 2)

- Monitoring, measurement, and instrumentation
- Best available monitoring methods
- Report and recordkeeping requirements (facility level and roll-up)
- Operator Panel

Monitoring and Measurement Requirements

Monitoring, Measurement and QA/QC Requirements

- Review of Monitoring Plan
- Review of sources requiring measurement
- Methods
- Instruments
- Calibration requirements
- Missing data

§98.234 – Monitoring and QA/QC Requirements

- Monitoring plan defines and explains monitoring processes and methods used for data collection
  - » Describes QA/QC procedures
  - » May rely on existing QA plans, standard operating procedures and other corporate documents

Review of T&S Source Types Requiring Measurement

- Reciprocating compressor venting
  - Including rod packing vents / leakage, isolation valve leakage vent, blowdown valve leakage vent
  - Measure blowdown valve leakage during operating and standby-pressurized modes;
  - Measure reciprocating compressor rod packing vent (or leakage, depending on configuration) during operating mode; and
  - Measure unit isolation valve leakage through the open blowdown valve vent during the not operating, depressurized mode.
- Centrifugal compressor venting (wet and dry seals)
  - Blowdown valve leakage through the blowdown vent for wet seal and dry seal compressors;
  - Unit isolation valve leakage through the open blowdown valve vent during the not operating, depressurized mode; and
  - Wet seal oil degassing vents for operating mode
- Transmission storage tanks venting (faulty dump valve)

Measurement Flexibility and Methods

- Inaccessible emission sources (e.g., as defined in 40 CFR part 60, are not exempt from Subpart W)
- Leak detection and through-valve leakage § 98.234(a)(1-5)
  - *Optical gas imaging instrument*
  - *Method 21* (40 CFR part 60, appendix A–7) monitoring
  - High volume sampler
  - *Acoustic leak detection device*
  - Flow meters
  - Composition analyzers
  - Pressure gauges
  - *Infrared laser beam illuminated instrument*
  - Calibrated bags (also known as vent bags)

§ 98.234(a)(1) and (3): Optical Gas Imaging Instrument

- Adapted military technologies that use principles of infrared light and optics
- Image of plumes – recordable
- Alkanes reside within the midwave spectra
- Must be used for all source types that are inaccessible (> 2 meters above a support surface)
- Any emissions detected by the optical gas imaging instrument is a leak unless screened by M21 and < 10,000 ppmv
- Hot Work Permit required - Not Intrinsically Safe

- Requires method in 40 CFR part 60, subpart A
  - » §60.18(i)(1) and (2) of the *Alternative work practice for monitoring equipment leaks*

§ 98.234(a)(2) – Method 21

- Typically applied to routine VOC leakage from valves, pumps, flanges, connectors, etc.
- Source screening is performed with a portable organic compound analyzer
  - » e.g., 'Sniffer', 'OVA', 'TVA'
- 10,000 ppm or greater is designated a leak
  - » i.e., leaker EF's applied to > 10,000 ppm leaks
- Previous work shows concentration is a poor surrogate for mass emissions

§ 98.234(a)(5): Acoustic Leak Detection Device

- Estimate through-valve leakage (closed systems)
  - » Ultrasonic measurement
  - » Leak is > 3.1 scf per hour
  - » Requires data on valve type, size, and differential pressure
  - » Readings upstream and downstream of valve, and on valve body

- Software estimates the leakage rate depending on decibel level
  - » Correlations developed from lab studies
  - » Accuracy for T&S is unknown

§ 98.234(a)(5): Acoustic Leak Detection Device

- Some ultrasonic leak detectors in use do not appear to meet the criteria of Subpart W
  - » e.g., "Ultra-Probe" ultrasonic leak detector

- Frequency tuning to "listen" for a leak and reduce background noise at other frequencies
  - » Does not determine through valve leakage per Subpart W requirement
- Would require BAMM request

Instrument Calibrations

- § 98.3(i)(1)(i): All measurement devices must be calibrated according to one of the following:
  - » Manufacturer's recommended procedures, or
  - » An appropriate industry consensus standard, or
  - » Method specified in a relevant subpart of this part
- The calibration method(s) used shall be documented in the Monitoring Plan

§ 98.234(b): Methods and Instrument Calibration

- Consult checklists for a more detailed summary of requirements…
- Flow meters, composition analyzers, and pressure gauges calibrated per § 98.3(i) and § 98.234(b)
- Estimate CH_4 and CO_2 volumetric and mass rates per §98.233(u) and (v)
- Monitor in accordance with the instrument manufacturer's operating parameters
- May use an appropriate consensus-based standard or industry standard practice
  - » e.g. ASTM, ANSI, AGA, ASME, API, etc. methods

§98.3(i): Calibration and Accuracy Specifications

- §98.3(i) flow meter calibration accuracy specs do not apply where either the use of company records or "best available information" is used to quantify fuel usage and/or other parameters (e.g., Tier 1 or Tier 2 combustion)
  - » Meter calibration accuracy of 5% only applies to meters specified by a Subpart (e.g., *required* metering for Tier 3)
- §98.3(i)(1)(i): For measurement devices other than *required flow meters*, the device must be calibrated to an accuracy within the appropriate error range for the specific measurement technology, based on an applicable operating standard, including but not limited to industry standards and manufacturer's specifications
  - » Applies to vent flow meters and other measurement devices

§ 98.3(i): Calibration and Accuracy Requirements

- For facilities subject to this part on January 1, 2010, the initial calibration shall be conducted by April 1, 2010
- An initial calibration is not required for flow meter or other measurement device that is within its cal period
- For facilities subject to this part after April 1, 2010, initial calibration shall be conducted by the date that data collection is required to begin
- Calibration postponements [§98.3(i)(6)] are permitted and must be documented in the plan
- Recalibration: Use the frequency recommended by the manufacturer or by an industry consensus standard practice. [§98.3(i)(1)(iii)(B)]

§98.234(c): Calibrated Vent Bags

- Typically Used to Measure
  - » Blow down valves
  - » Unit valves
  - » Scrubber dump
  - » Valves and pressure relief valves
  - » Rod packing systems
- Average three readings of time to fill bag
- Calibrated against rotameter and found accurate to within ±10%
- *Measure leaks as large as 240 scfm of natural gas*
- Estimate CH_4 and CO_2 volumetric and mass rates per §98.233(u) and (v)

§98.234(d): High Volume Sampler

- Combine concentration and flow rate measurements to produce mass emissions
- Upper flow rate limit about 14 m^3/hr (494 ft^3/hr)
- Complete capture of the equipment leak without creating backpressure on the source
- 10 to 30 leak-rate measurements per hour
- Estimate CH_4 and CO_2 volumetric and mass rates per § 98.233(u) and (v)
- Calibrate the instrument at 2.5 percent methane with 97.5 percent air and 100 percent CH_4
- Follow manufacturer's instructions

§ 98.235: Procedures for Estimating Missing Data

- Complete record of all estimated and/or measured parameters used in the GHG emissions calculations is required
- Lost or errant data must be repeated ASAP
- If missing data are not discovered until after December 31, in subsequent year
- Documented best available data may be used in emissions determinations for missing continuously monitored or measured data, or for required missing temperature or pressure data

Missing Data

- For each missing data event, retain [§98.3(g)(4)]:
  - Record of the duration of the event,
  - Actions taken to restore malfunctioning monitoring equipment,
  - Cause of the event, and
  - Actions taken to prevent or minimize occurrence in the future [This provision changes in November 2010 revs]
- Annual report to document each data element for which a missing data procedure was used (according to the procedures of an applicable subpart), and the total number of hours in the year that a missing data procedure was used for each data element [§98.3(c)(8)]

Best Available Monitoring Methods

Best Available Monitoring Methods

- In response to the proposed rule, many significant comments were submitted regarding the need for alternatives to address:
  - Timing issues for 2011 implementation
  - Safety concerns for vent measurement – especially with 2011 mandate
  - Availability of data with "start-up" on 1/1/11
  - Availability of service providers
  - Development of processes and methods to address QA/QC and other criteria to ensure quality data
- EPA addressed this in Subpart W with BAMM
  - Several categories where BAMM *may* be available

Best Available Monitoring Methods

- If BAMM applies, §98.233 methods and calculations *must be used* but other procedures can be used for estimating parameters for calculations, including:
  - Monitoring methods currently used by the facility that do not meet the specifications of this subpart
  - Supplier data
  - Engineering calculations
  - Other company records
- Options available for transmission and storage are included in §98.234(f)(3) through (5)

BAMM Categories

- One category allows alternatives through June '11 without the need for a request or EPA approval
  - Activity data for specific methods
  - Typically related to data collection that would otherwise be required starting January 1 (More detail to follow)
- Other categories require submittal of a request and EPA approval
  - BAMM for leak detection or vent measurement through December 31, 2011
  - BAMM for other sources through 2011
  - BAMM for unique circumstances beyond 2011

BAMM for Specific Activity Data
Automatically Allowed through June 30

- §98.234(f)(3) allows BAMM from January 1 through June 30, 2011 and does NOT require EPA approval for *activity date from select source types* that include:
  - » Cumulative hours of venting, days, or times of operation for centrifugal compressors vents, reciprocating compressor vents, and equipment leaks based on leaker or population emission factors
  - » Number of blowdown events
  - » Cumulative volume produced, volume input or output, or volume of fuel used for transmission storage tanks or flaring
- Operators can request BAMM through December 31, 2011 for these sources, but that requires submittal of a request and EPA approval

BAMM
For 2011 Leak Surveys or Vent Measurement

- T&S sources that require vent measurement or leak surveys can apply for BAMM through 2011 [§98.234(f)(4)]
- Request criteria defined in §98.234(f)(5)
  - » Request must be submitted by April 30
  - » Request requires detailed explanation and substantiation of the need for extension (examples in later slide)
- *"Approval criteria.* To obtain approval, the owner or operator must demonstrate to the Administrator's satisfaction that it does not own the required monitoring equipment, and it is not reasonably feasible to acquire, install, and operate a required piece of monitoring equipment or to obtain leak detection or measurement services in order to meet the requirements of this subpart for 2011" [§98.234(f)(5)(iii)(C)]

BAMM
For *Other* Sources through December 2011

- EPA indicates that sources other than (f)(3) [automatic BAMM] and (f)(4) [leak surveys or vent measurement] can also apply for BAMM [§98.234(f)(5)(iv)]
- Similar process as for (f)(4), but request to include:

  "A description of the data collection methodologies that do not meet safety regulations, technical infeasibility, or specific laws or regulations that conflict with each specific source for which an owner or operator is requesting use of best available monitoring methodologies."
- This category identifies *safety* issues as basis for BAMM, but §98.234(f)(5)(iv) [see 75 FR 74507] indicates it applies to sources *not listed* in other BAMM sections
  - » Rule text implies that safety criteria is not a basis to justify BAMM for vent measurement and leak surveys listed in (f)(4)

BAMM
Beyond December 2011

- BAMM can be requested beyond 2011 for extreme or unique situations
- Request must be submitted by September 30
- "EPA does not anticipate a need for approving the use of best available methods beyond December 31, 2011, except in extreme circumstances, which include safety, a requirement being technically infeasible or counter to other local, State, or Federal regulations."

BAMM Request: Schedule Summary and Request Requirements

- Requests for extensions through 2011 must be submitted by April 30, 2011
- Requests for extensions beyond 2011 must be submitted by September 30, 2011
- Requests must include detailed information:
  - » List of sources, measurements, instruments, etc. for which the request is submitted
  - » List of applicable rule sections
  - » Documentation of efforts to fulfill obligation, including service providers and companies contacted
  - » Actions to be taken (e.g., acquiring equipment) and date by which equipment or service will be provided

Reporting and Recordkeeping

- Facility-level requirements and information roll-up

Annual Report Requirements: Facility-level

- Compliance Checklists detail reporting and recordkeeping requirements
- General facility report requirements [§98.3]:
  - Annual report submitted by March 31 of next calendar year
  - Electronic reporting tool in development
  - Facility name, ID number, and address
  - Year and months covered by the report
  - Date of submittal
  - Legal name(s) and physical address(es) of the highest-level U.S. parent company(s) of the reporting entity and the percent ownership interest for each listed parent company
  - Primary NAICS code, and additional NAICS code(s)
  - Whether facility has cogeneration unit emissions

Annual Report Requirements: Facility-level

- General facility report requirements [§98.3] (continued):
  - A signed and dated certification statement provided by the designated representative of the owner or operator
- Certificate of representation (for designated representative) submitted at least 60 days before the initial report deadline
  - §98.4 addresses authorization and responsibilities of the designated representative
- Complete certificate of representation includes:
  - Identification of the facility
  - Name, organization, and contact information for the designated representative and any alternate designated representative
  - List of the facility owners and operators
  - Required certification statements and signatures
- Suggest legal counsel review §98.4 – Authorization and responsibilities of the designated representative

Electronic Greenhouse Gas Reporting Tool (e-GGRT)

- All GHG MRR reporting will be electronic
  - Built-in calculations
  - When available (i.e., data fields), may help answer questions regarding reporting requirements (or cause more confusion)
- Report and certificate of representation submitted electronically
- Electronic Greenhouse Gas Reporting Tool (e-GGRT) is still in development
  - Web-based system being developed by EPA
  - Version 1.0 includes only those data elements that apply for 2010
  - EPA is also exploring the possibility of allowing facilities subject to both federal and state GHG reporting requirements to upload their data annually, via a single Extensible Markup Language (XML) reporting schema

e-GGRT Notes

- Likened to Turbo Tax
- Does NOT support Part 98 recordkeeping requirements
- Equipped to handle confidential business information
- EPA has indicated it will launch e-GGRT for registration soon
- Facilities must register online through the e-GGRT system
  - January 31, 2012 for subpart W
- To register as a new e-GGRT user:
  - Create New User Profile
  - Sign, date, and mail in your Electronic Signature Agreement
  - EPA approval – account activation
  - Start Using e-GGRT

Annual Report Requirements: Facility-level

Requirements (in addition to "source-specific" reporting discussed earlier) include:

- Annual facility emissions
  - » CO_2e (metric tons) aggregated for all GHG
  - » CO_2, CH_4, and N_2O (metric tons) from Subpart W emission sources
  - » CO_2, CH_4, and N_2O (metric tons) from Subpart C emission sources
- Supplemental Reporting (in response to EPA inquiry)
  - » Within 30 days of receipt of a written request from the Administrator:
    - – Submit an explanation of how company records are used to quantify fuel consumption
    - – Submit HHV determination methods and fuel sample dates; OR the dates on which fuel HHV analysis results are received from the fuel supplier

Annual Recordkeeping: Subpart A Facility Requirements

- General facility recordkeeping requirements include:
  - » Retain required records for at least 3 years in an electronic or hard-copy format suitable for review
  - » List of all units, operations, processes, and activities for which GHG emissions were calculated
  - » Annual GHG report
  - » Written GHG Monitoring Plan
  - » Documentation of all requests and approvals for all uses of best available monitoring methods

Annual Recordkeeping: Subpart A Emission Source Requirements

- General recordkeeping requirements for emission sources include:
  - » Data used to calculate GHG emissions for each unit, operation, process, and activity:
    - – GHG emissions calculations & methods (refer to Mon. Plan)
    - – Analytical results to develop site-specific EFs
    - – Results of required analyses for fuel, gas HHV, etc.
    - – Facility operating data or process information
  - » Missing data computations
    - – For each missing data event, record the cause of the event and corrective action
  - » Results of required certification and QA tests (e.g., calibrations) of instrumentation used to provide GHG reporting data
  - » Maintenance records for instrumentation used to provide GHG reporting data

Annual Recordkeeping: Subpart W Facility Requirements

- Gas composition – Methane and CO_2 content:
  - » Gas sampling & analysis methods (refer to Monitoring Plan)
  - » Results of natural gas analyses for CH_4 and CO_2
  - » Measurement dates
  - » Missing data procedures (as applicable):
    - – Record each missing data element, the associated computation, the cause of each missing data event and the corrective action taken
    - – Record the total hours that each missing data procedure was used
  - » Natural gas analysis instrumentation (e.g, gas chromatograph)
    - – Results of certification and QA tests (as applicable)
    - – Maintenance records (as applicable)

Annual Recordkeeping: Subpart W Emission Source Requirements

- General recordkeeping requirements for Subpart W:
  - Dates on which measurements were conducted
  - Results of all emissions detected and measurements
  - Calibration reports for detection and measurement instruments
  - Inputs and outputs of calculations or emissions computer model runs used for engineering estimation of emissions
- See earlier slides on "source types" for additional "source-level" requirements that apply

Schedule for Monitoring and Reporting for Subpart W

Date	Monitoring/Reporting Item
January 1, 2011	Data collection begins
April 1, 2011	Monitoring plans completed
April 30, 2011	Deadline for BAMM request beyond June 30, 2011
June 30, 2011	Start collecting data using the required methods (unless BAMM extension is granted)
September 30, 2011	Deadline for BAMM request beyond December 31, 2011
January 30, 2012	Certificate of Representation due
March 31, 2012	Annual Report Due

Questions?

Operator Panel

Summary of Issues Requiring Clarification

- List of Issues and Questions from Workshops

Implementation Issues and Questions

- Questions and issues requiring clarification will be compiled from the workshops
- INGAA is developing a list of questions and issues for submittal to EPA

Initial List of Implementation Questions

- [Add items from meeting]

Questions, Feedback, and Final Discussion