CALIFORNIA
AIR RESOURCES BOARD

Verifier Accreditation Training for Mandatory GHG Reporting

General Verification

Course 1.2 - Stationary Fuel Combustion

Verifier Accreditation Training for Mandatory Greenhouse Gas Reporting

Course 1: General Verification

- 1.1 Verification Context, Principles, and Program Overview
- **1.2 Stationary Fuel Combustion and Sorbent Sources**
- 1.3 Accuracy and Product Data
- 1.4 Electricity Generating Units and Cogeneration

Course 1.2 Stationary Fuel Combustion (SFC) and Sorbent Sources (MRR §95115)

- Overview
  - SFC Applicability: source categories, reporting thresholds, covered emissions
  - Aggregation of SFC units
  - Comparing §95115 requirements to US EPA's 40 CFR 98, Subpart C
  - Verifying correct methods to calculate GHG emissions
- Verifying combustion emissions
- Verifying sorbent emissions
- Verifying biomethane and biomass CO_2 emissions

Entities Subject to §95115 - Reporting Thresholds

Entities are required to report when any of these criteria are met:

- Stationary combustion + process emissions ≥ 10,000 MT CO_2e (§95101(b)(2))
  - Oil and gas production facilities include emissions from portable equipment and flares when calculating reporting threshold
- "All-in" categories of reporting entities (§95101(a)(1)(A))

Entities Subject to §95115 - Source Categories

- Source categories that must report regardless of emissions levels (§95101(a)(1)(A)):
  - Electricity generation units subject to 40 CFR Part 75
  - Cement production
  - Lime manufacturing
  - Nitric acid production
  - Petroleum refineries
  - Geologic sequestration of carbon dioxide

Entities Subject to §95115 - Source Categories

- Source categories that must report when combustion and process emissions exceed 10,000 MT CO_2e annually (§95101(a)(1)(B)):
  - Stationary fuel combustion
    - Electricity generating units not subject to 40 CFR Part 75
  - Glass production
  - Hydrogen production
  - Iron and steel production
  - Pulp and paper manufacturing
  - Petroleum and natural gas systems;

Entities Subject to §95115 - Source Categories

- Non-industrial facilities only report combustion emissions
  - Universities, hospitals, military bases, large government buildings (boilers, electricity generation units, cogeneration)
  - Electricity generating units (EGUs) and cogeneration may have additional requirements under §95112, discussed in Course 1.4
- Industrial facilities may have combustion and process emissions, for example:
  - Glass production[1]
  - Cement plants[1]
  - Electricity generating units with wet flue gas desulfurization system

[1] Process emissions specialty required

Entities Subject to §95115 - GHGs to Report

- CO_2 from fossil fuel combustion
- CO_2 from biomass-derived fuel combustion
  - Exempt and non-exempt biomass
- CH_4 and N_2O from fossil and biomass fuel combustion
- CO_2 sorbent emissions

MRR generally references calculation methods in Subpart C

Entities Subject to §95115(h): Aggregation of SFC Units

- Small units: units may be aggregated if (40 CFR § 98.36(c)(1))*:
  - Units have a max heat input of ≤250 MMBtu/hr
  - Units are not required or elect to use Tier 4 method
  - Units use the same tier for any common fuels combusted
- Common stack: Units have a monitored common stack using a CEMS (40 CFR §98.36(c)(2))
- Common pipe: Units share a common liquid or gaseous fuel pipe (>250 MMBtu/hr is acceptable) (40 CFR 98.36(c)(3))*
  - Verify the reporter accounted for any fuel diverted from those units
  - Verify correct tier is used
- Combined large and small units: Common liquid or gaseous fuel is shared between large units and small combustions sources (40 CFR §98.36(c)(4))*
  - Verify reporter complies with 98.36(c)(4)(i) - (iii)

*Units must be from the same source category

California MRR and US EPA 40 CFR Part 98

- Both the federal government and the State of California require GHG reporting
- MRR is structured to incorporate US EPA rule (40 CFR Part 98, Subpart C) by reference
- Key distinctions between MRR and Part 98 will be discussed

Introduction to 40 CFR Part 98, Subpart C (1 of 2)

- Four Tiers (methods) for calculating CO_2 based on
  - Unit Size
  - Fuel Type
  - Other Factors
- CH_4 and N_2O are calculated depending on CO_2 Tier using
  - Measured therms or MMBtu and default EF or
  - Measured fuel mass or volume and either
    - Default EF and default HHV or
    - Default EF and measured HHV
- MRR specifies a particular version of Subpart C* (§95100(c)) – only the specified version may be used
- Verifiers must confirm they are using the version posted on CARB's website and not an older or newer version

*http://www.arb.ca.gov/cc/reporting/ghg-rep/regulation/subpart_c_rule_part98.pdf

Introduction to 40 CFR Part 98, Subpart C (2 of 2)

Tier 1: Default EF and default HHV or measured therms
(40 CFR § 98.33(a)(1))

$$CO_2 = 1x10^{-3} * Fuel * HHV * EF \quad \text{(Eq. C-1)}$$

Tier 2: Default EF and annual weighted average HHV
(40 CFR § 98.33(a)(2))

$$CO_2 = 1x10^{-3} * Fuel * HHV * EF \quad \text{(Eq. C-2a)}$$

Tier 3: Average carbon content and molecular weight
(40 CFR § 98.33(a)(3))

$$CO_2 = \frac{44}{12} * Fuel * CC * \frac{MW}{MVC} * 0.001 \quad \text{(Eq. C-5)}$$

Tier 4: CO2 CEMS
(40 CFR § 98.33(a)(4))

$$CO_2 = 5.18x10^{-7} * C_{CO2} * Q \quad \text{(Eq. C-6)}$$

Key distinctions between MRR & Subpart C (1 of 2)

- Reporting threshold:
  10,000 MT CO_2e (MRR) vs. 25,000 MT CO_2e (EPA)
- MRR uses same methods as Subpart C but:
  - MRR requires the use of higher tiers than Subpart C for some fuel and equipment size combinations
  - MRR requires reporting of GHG emissions from ALL fuels
    - For fuels not listed in Table C-1, Subpart C only requires units >250 MMBtu/hr and fuels ≥ 10% of annual heat input to report GHGs
    - For fuel providing <10% of heat input to a unit ≤250 MMBtu/hr, MRR reporter may use any method allowed by 40 CFR §98.33(b)

Key distinctions between MRR & Subpart C (2 of 2)

- MRR reporters:
  - Required to report GHG emissions from pilot lights if operated ≥300 hours/year
  - May use a site-specific source test for CH_4 and N_2O, whereas Subpart C only allows default CH_4 and N_2O emission factors
  - May use monthly fuel analysis instead of quarterly flue gas analysis in determining biomass fraction for partially biogenic fuels other than MSW (for example, tires)
  - Must use global warming potentials (GWP) from the Fourth Assessment (AR4)
    - Most recent EPA Part 98 uses Fourth Assessment (AR4)

Updated from 2020 training. See errata.

Verifying Correct Methods (1 of 2)

- Verify reporter is using correct method according to §95115 for each fuel type and unit size
  - See Handout #1.2.1 for a table of minimal allowable methods based on unit size and fuel type and a decision tree diagram
- Reporting entities may always use a higher tier than the minimum required by the regulation
- Method should be consistent with previous year unless reporters follow and document change of methodology requirements (§95103(m))
  - Review GHG Monitoring Plan and previous emissions data report (EDR) to confirm acceptable methods

Verifying Correct Methods (2 of 2)

- If reporter is using §95115(c)(3), which allows use of any tier for the emissions calculation if:
  - Emissions are *de minimis* under §95103(i); or
  - Fuel provides <10% heat input to unit with a maximum heat capacity of ≤ 250 MMBtu/hr
    - Unless prohibited by 40 CFR §98.33(b)
- Then verify (as applicable):
  - Emissions are de minimis
  - Does reporter have records and calculations supporting fuel and unit size limits?
  - Method selected for calculating GHG emissions is allowed for that fuel and unit size by 40 CFR §98.33(b)?

Course 1-2: Stationary Fuel Combustion

- Overview
- **Verifying combustion emissions**
  - **CO_2 Emissions**
    - **Tiers 1-3**
    - Tier 4
    - Part 75
  - CH_4 and N_2O Emissions
- Verifying sorbent emissions
- Verifying biomethane and biomass CO_2 emissions

Types of Evidence for Verifying CO_2

- GHG Monitoring Plan
- Fuel consumption data
- Measured data and measurement methodologies
  - High heat value (HHV)
  - Carbon content
  - Molecular weight
- Evidence of accuracy of meters and monitors
  - Calibration records
  - Linearity checks and other quality assurance procedures
- Missing data procedures and records

Verifying Fuel Consumption

- Evidence to request
  - Fuel consumption records by fuel type
  - Methodology and supporting data used to reconstruct or replace missing data
- How to examine evidence
  - Examine fuel consumption records for completeness and accuracy
  - Confirm missing data procedures were followed:
    - Demonstrate reasonable efforts to capture 100% fuel consumption data; follow procedures in §95129(d)

Verifying Tier 1 Reports

- $CO_2 = 1x10^{-3} * Fuel * HHV * EF$ (Eq. C-1)
- Confirm
  - Fuel consumption records
  - Correct default HHV values were used
  - Correct CO_2 emission factors were used
  - Your calculation matches the reporter's calculations
  - Missing data procedures were followed (Course 1.3)
    - Demonstrate reasonable efforts to capture 100% fuel consumption and HHV
    - Follow applicable procedures in §95129(c) and (d)

Verifying Tier 2 Reports (1 of 2)

$$CO_2 = 1x10^{-3} * Fuel * HHV * EF \quad (Eq.\ C\text{-}2a)$$

- Confirm
  - Fuel consumption records
  - Correct measured HHV values were used
  - Correct CO_2 emission factors were used
  - Correct input into Cal e-GGRT
  - Your calculation matches the reporter's calculations

Verifying Tier 2 Reports (2 of 2)

$$CO_2 = 1x10^{-3} \text{ Steam}*B*EF \quad \text{(Eq. C-2c)}$$

- Documentation to request when municipal solid waste facility uses steam production to calculate CO_2
  - Total mass of steam generated during the reporting year (lb steam)
    - Confirm device accuracy and appropriateness of calculation
  - Ratio of the boiler's maximum rated heat input capacity to its design rated steam output capacity (MMBtu/lb steam) (B)
    - Should be a constant: Confirm appropriate source documentation
  - Use of correct fuel-specific default CO_2 emission factor, from Table C–1 (kg CO_2/MMBtu)

Verifying Tier 3 Reports (1 of 3)

- More complicated methodology; higher risk of error
- Three different formulae, depending upon type of fuel: solid, liquid, gaseous
- CO_2 emissions calculated from fuel consumption, carbon content (CC) and, for gaseous fuels, molecular weight (MW)
- CC and MW is required to be sampled based on fuel type per 40 CFR §98.34(b)(3)(ii)

Verifying Tier 3 Reports (2 of 3)

- Confirmation of measurement accuracy for 40 CFR §98.3(i) and §95103(k) where applicable
  - Solid fuels - may use “company records” but must still be +/-5% accurate
  - Liquid and gaseous fuels
    - Calibrated fuel meter
    - Fuel billing (revenue) meter
    - For liquid fuels, tank drop measure using consensus-based standard (e.g., ASTM, API, ASME)

Verifying Tier 3 Reports (3 of 3)

- Carbon content (CC) for each fuel
  - Measured at the frequency specified in §95115(f), and by methods specified in 40 CFR §98.34(b)(3)
- For gaseous fuels
  - Molecular weight (MW) measured at the frequency specified in §95115(f), and by methods in 40 CFR §98.34(b)(3) and the temperature-dependent molar volume conversion (MVC) factor used
- For pre-mixed blended fuels
  - Data to calculate the blend's annual average value of CC and MW, if appropriate, as in 40 CFR 98.34(b)(3)(v)

Evaluating Tier 3 Evidence

- Does reporter have records of
  - Fuel consumption?
  - CC?
  - And for gaseous fuels, MW determination?
- Were CC and MW measured using correct methods at correct frequency and was the annual weighted average calculated correctly?
- Where was the sampling location(s)?
- Gaseous fuels
  - Did reporter use correct MVC for standard conditions (temperature) at which fuel volume was measured?

Sample Calculations

- CO_2 Emissions from a SFC Source Group Participation Exercise 1-2.1
- Scenario
  - Fuel: Natural gas (primary fuel for a boiler)
  - HHV: 1.035 $x10^{-3}$ MMBtu/scf (measured)
  - Consumption: 500,000,000 scf

- What are CO_2 emissions?
  - A. 27,437,850 MT CO_2/yr
  - B. 27,438 MT CO_2/yr
  - C. 27,252 MT CO_2/yr

Sample Calculations - Solution

- Scenario
  - Fuel: Natural gas (primary fuel for a boiler)
  - HHV: 1.035 x10^{-3} MMBtu/scf (measured)
  - Consumption: 500,000,000 scf

- The correct answer is B:
  - CO_2 EF from Table C-1 is 53.02 kg CO_2/MMBtu
  - Use eq. C-2a: $CO_2 = 1 \times 10^{-3} \times Fuel \times HHV \times EF$:
    - (1 x 10^{-3} MT/kg) x (5 x10^{8} scf) x (1.035 x10^{-3} MMBtu/scf) x (53.02 kg CO_2/MMBtu) = 27,438 MT CO_2

- Overview
- **Verifying combustion emissions**
  - **CO_2 Emissions**
    - Tiers 1-3
    - **Tier 4**
    - Part 75
  - CH_4 and N_2O Emissions
- Verifying sorbent emissions
- Verifying biomethane and biomass CO_2 emissions

Continuous Emissions Monitoring System (CEMS)

- Collects hot stack gasses to directly measure [CO_2]
  - Fuel usage is reported to CARB, but is NOT used for CO_2 emissions calculations
- Direct compliance instrument for air district rules
  - Primarily for NOx and CO limits

Verifying Tier 4 (CEMS) Reports (1 of 3)

- Verifier must collect information on
  - Hourly CEMS concentration, flow and calculated CO_2 mass
  - Records of dates and results of CEMS certifications and quality assurance procedures
  - Methodology and supporting data used to reconstruct or replace missing data
- Observation is key here
  - Visit CEMS "shack", discuss outputs with CEMS technician
  - Visit control room to identify how data is recorded
  - Locate data transmitters and all meters on the site
  - Ask for a live demonstration and output from the Data Acquisition and Handling System

Verifying Tier 4 (CEMS) Reports (2 of 3)

- Evidence to request
  - CEMS Certifications
    - Records of dates
    - Results of:
      - Certifications
      - Quality assurance Procedures including
        - Linearity checks
        - Cylinder gas audits
        - Relative accuracy test audit
  - Information should be included in the reporter's GHG Monitoring Plan

Verifying Tier 4 (CEMS) Reports (3 of 3)

- Evidence to request
  - Fuel consumption
    - Solid fuels may use “company” records
    - Liquid and gaseous fuels - calibrated fuel meter meeting 40 CFR §98.3(i), or tank drop measure
    - Fuel consumption records do not need to meet measurement accuracy requirements for CO_2
    - Information to understand the CO_2 mass calculation, especially moisture correction

Evaluating Tier 4 Evidence (1 of 2)

- Verifier must check actual (daily) CEMS data to "recalculate" data as required by regulation
  - Sample the CEMS data produced through the DAHS
  - Ask the operator to query the data while you are on site

- Calculate CO_2 emissions using Tier 1 to cross-check
  - Calculated CO_2 emissions should be in general agreement with CO_2 emissions measured by CEMS, but some difference is expected

Evaluating Tier 4 Evidence (2 of 2)

- Determine whether the CEMS certifications and quality assurance procedures conform with the requirements in:
  - 40 CFR Part 60
  - 40 CFR Part 75
  - Or the relevant air district program under which the CEMS is operated
- Ensure CEMS missing data procedures have been followed

- Overview
- **Verifying combustion emissions**
  - **CO_2 Emissions**
    - Tiers 1-3
    - Tier 4
    - **Part 75**
  - **CH_4 and N_2O Emissions**
- Verifying sorbent emissions
- Verifying biomethane and biomass CO_2 emissions

Verifying CO_2 Emissions - 40 CFR Part 75

- Developed as part of U.S. EPA's Acid Rain Program
  - Data available on public website
- Regulates EGUs (Electricity Generating Units)
- Requires continuous monitoring and reporting of, among other gases, CO_2 mass emissions and reporting of heat input
- First cap-and-trade program - SO_2
- Includes
  - Monitoring Provisions
  - Operation and Maintenance Requirements
  - Missing Data Substitution Procedures
  - Record Keeping and Reporting Requirements
- Useful tool: US EPA's Plain English Guide to the Part 75

http://www.epa.gov/airmarkets/emissions/docs/plain_english_guide_par75_final_rule.pdf

Verifying CO_2 Combustion Emissions Calculated Using Fuel-based Methodology in 40 CFR §75.13(b) (1 of 6)

- Where Part 75 estimates are not based on measured concentrations of CO_2
- Allowed under 40 CFR §75.10(3)(ii): Appendix G
- Based on measured heat content of the fuel and amount of fuel combusted (and sorbent where applicable)
- Operator calculates daily, quarterly and annual CO_2 mass emissions

Verifying CO_2 Combustion Emissions Calculated Using Fuel-based Methodology in 40 CFR §75.13(b) (2 of 6)

Text of 40 CFR §75.13(b)

Determination of CO_2 emissions using appendix G to this part. If the owner or operator chooses to use the appendix G method, then the owner or operator shall follow the procedures in appendix G to this part for estimating daily CO_2 mass emissions based on the measured carbon content of the fuel and the amount of fuel combusted.

For units with wet flue gas desulfurization systems or other add-on emissions controls generating CO_2, the owner or operator shall use the procedures in appendix G to this part to estimate both combustion-related emissions based on the measured carbon content of the fuel and the amount of fuel combusted and sorbent-related emissions based on the amount of sorbent injected.

The owner or operator shall calculate daily, quarterly, and annual CO_2 mass emissions (in tons) in accordance with the procedures in appendix G to this part.

Verifying CO_2 Combustion Emissions Calculated Using Fuel-based Methodology in 40 CFR §75.13(b) (3 of 6)

- Appendix G provides two basic methods for determining CO_2 emissions:
  - Daily CO_2 emissions are calculated from company records of fuel usage and the results of periodic fuel sampling and analysis (to determine the % carbon in the fuel); or
  - Hourly CO_2 emissions are calculated using heat input rate measurements made with certified Appendix D fuel flow meters together with fuel-specific, carbon-based "F-factors".

Verifying CO_2 Combustion Emissions Calculated Using Fuel-based Methodology in 40 CFR §75.13(b) (4 of 6)

$$W_{CO2} = \frac{(MW_C + MWO_2) * WC}{2{,}000\ MWC}$$ Eq. G-1

W_{CO_2} = CO_2 emitted from combustion, tons/day
MW_C = Molecular weight of carbon (12.0)
MW_{O2} = Molecular weight of oxygen (32.0)
W_C = Carbon burned, lb/day, using fuel analysis and fuel feed rates

$$W_{CO2} = \frac{F_c * H * Uf * MWCO_2}{2{,}000}$$ Eq. G-4

W_{CO_2} = CO_2 emitted from combustion, tons/hr
MW_{CO_2} = Molecular weight of CO_2, 44.0 lb/lb-mole
F_c = Carbon based F-factor, 1,040 scf/mmBtu for natural gas (see section 3.3.5 of appendix F)
H = Hourly heat input in mmBtu (see section 5 of appendix F)
U_f = 1/385 scf CO_2/lb-mole at 14.7 psia and 68 °F

Verifying CO_2 Combustion Emissions Calculated Using Fuel-based Methodology in 40 CFR §75.13(b) (5 of 6)

- Evidence to request for <u>natural gas</u>
  - Hourly fuel flow rates from company records
  - Measured high heating value (HHV/GCV) from fuel sampling
  - Determine the carbon content of each fuel sample
    - The carbon-based F factor (F_c) (i.e., ratio of CO_2 generated to the calorific value of the fuel combusted)
  - Methodology and supporting data used to reconstruct or replace missing data

Verifying CO_2 Combustion Emissions Calculated Using Fuel-based Methodology in 40 CFR §75.13(b) (6 of 6)

Confirm:

- Appropriate fuel flow used
- Records and methodologies for HHV/gross calorific value (GCV) determinations
- Heat input appropriately calculated per Appendix F to Part 75, Section 5.5 (conversion procedures)
- Correct F_c factors were used for specific fuel
- Missing data procedures were followed
  - 40 CFR §75 for CO_2 concentration, stack gas flow rate, fuel flow rate, high heating value, and fuel content (in particular Appendix G, Section 5)

CH_4 and N_2O Emissions (1 of 2)

Emissions calculated using procedures in 40 CFR §98.33(c)

$$CH_4 \text{ or } N_2O = 0.001 * Fuel * HHV * EF \quad \text{(Eq. C-8 for all fuels)}$$
$$CH_4 \text{ or } N_2O = 0.001 * Fuel * EF \quad \text{(Eq. C-8b for NG reported in MMBtu)}$$

If 789,000 MMBtu of natural gas is combusted…

- CH_4 = 0.001 MT/kg * 789,000 MMBtu * 0.001 kg/MMBtu
- N_2O = 0.001 MT/kg * 789,000 MMBtu * 0.0001 kg/MMBtu
- CO_2 = 0.001 MT/kg * 789,000 MMBtu * 53.02 kg/MMBtu (Eq. C-1b)

GWPs

Total CO_2e = CO_2 + [CH_4*25] + [N_2O*298]

= 41,832.8 + [0.79*25] + [0.079*298] = 41,876 MT

Updated from 2020 training. See errata.

CH_4 and N_2O Emissions (2 of 2)

- Did reporter:
  - Use same values for fuel consumption as for calculating CO_2 emissions under Tiers 1 or 3?
  - Use same values for fuel consumption and HHV, or for steam production, under Tier 2?
  - Have values for total annual heat input for units using Tier 4? What is the source of those values?
- How to evaluate evidence
  - Were the EFs from Table C-2 used for the correct fuel, unless facility used source-specific EFs?
  - For blended fuels, were emissions calculated for each individual fuel separately using procedures in 40 CFR §98.33(c)?
  - Do verifier calculated emissions match reported emissions?

- Overview
- Verifying combustion emissions
  - CO_2 Emissions
    - Tiers 1-3
    - Tier 4
    - Part 75
  - CH_4 and N_2O Emissions
- **Verifying sorbent emissions**
- Verifying biomethane and biomass CO_2 emissions

CO_2 Emissions from Sorbent: Equation and Inputs

$$CO_2 = 0.91 * S * R * \left(\frac{MW_{CO2}}{MW_S} \right) \qquad \text{(Eq. C-11)}$$

CO_2 = CO_2 emitted from sorbent for the reporting year (MT)

0.91 = Conversion factor from short tons to metric tons

S = Limestone or other sorbent <u>used</u> in the reporting year, from company records (short tons)

R = The number of moles of CO_2 released upon capture of one mole of the acid gas species being removed (R = 1.00 when the sorbent is $CaCO_3$ and the targeted acid gas species is SO_2)

[$CaCO_{3(s)} + SO_{2(g)} \rightarrow CaSO_{3(s)} + CO_{2(g)}$]

MW_{CO_2} = Molecular weight of carbon dioxide (44)

MW_S = Molecular weight of sorbent (100 if calcium carbonate)

Verifying CO_2 Emissions from Sorbent

- Evidence to request: Inputs and outputs used in Eq. C-11 in 40 CFR §98.33(d)
- How to evaluate evidence - Does the reporter have:
  - Company records supporting the reported type and annual amount of sorbent used?
  - Data or information supporting the values used in Eq. C-11?
    - R = moles of CO_2 released per mole of acid gas being removed
    - MW_S = molecular weight of the sorbent

Selecting the Correct Tier
Group Participation Exercise 1.2.2

- A pipeline natural gas-fired boiler that is 300 MMBtu/hr maximum rated heat input; the consumption is measured in therms and obtained from billing records, and the unit has no CEMS.
- What is the minimum allowable reporting Tier?

  A. Tier 1

  B. Tier 2

  C. Tier 3

  D. Tier 4

Selecting the Correct Tier
Group Participation Exercise 1.2.2 Solution

- A pipeline natural gas-fired boiler that is 300 MMBtu/hr maximum rated heat input; the consumption is measured in therms and obtained from billing records, and the unit has no CEMS.
- What is the minimum allowable reporting Tier?

A. Tier 1

B. Tier 2

C. Tier 3

D. Tier 4

Use Equation C-1a using Therms; **C-1 is not allowed** because heat input is >250 MMBtu/hr -- see §95115(c)(1).

Selecting the Correct Tier
Group Participation Exercise 1.2.3

- A single-cycle peaking turbine (EGU) that combusts kerosene-type jet fuel with a heat input of 365 MMBtu/hr. The unit has no CEMS. What is the minimum tier?
  A. Tier 1
  B. Tier 2
  C. Tier 3
  D. Tier 4

Selecting the Correct Tier
Group Participation Exercise 1.2.3 Solution

- A single-cycle peaking turbine (EGU) that combusts kerosene-type jet fuel with a heat input of 365 MMBtu/hr. The unit has no CEMS. What is the minimum tier?

  A. Tier 1

  B. Tier 2

  C. Tier 3

  D. Tier 4

- Jet fuel meets the definition of distillate fuel oil in §95102, so either Tier 1 or 2 may be used according to Table 2-3 at the end of §95115. However, Tier 1 is limited to units <250 MMBtu, so Tier 2 is the correct answer.

Evaluating Additional Conformance Requirements §95131(b)(8)(F)

- Reporting entities that combust natural gas
  - Review natural gas bills
  - Confirm total amount reported in subpart A - compare with sum of gas combusted in Subpart C (or D)
  - Confirm natural gas provider -- should be gas utility company, not fuel “marketer”
- Purchased or acquired natural gas (MMBtu) must be reported even if the facility reports GHG emissions using data from internal meters

- Overview
- Verifying combustion emissions
- Verifying sorbent emissions
- **Verifying biomethane and biomass CO_2 emissions**

Biomass-Derived Fuels and Biomethane

- Biomass fuels are fuels that are derived from biomass products and byproducts, wastes, and residues from plants, animals, and microorganisms
  - Biomass fuels may be solid, liquid, or gaseous

- "Biomethane" means biogas that has been processed and meets pipeline quality natural gas standards

(Not all biogas is biomethane)

Verifying Biomass-Derived Fuel Emissions §95103(j); §95131(i); C&T §95852.2(a)

- Why is it important?
- Who has to report?
- What are the reporting requirements for fuels?
- How to verify biomass-derived fuel combustion emissions?

Importance of Biomass-derived Fuel Reporting

- Emissions from exempt biomass have no compliance obligation pursuant to Cap-and-Trade Regulation
  - Reporting and verification is still mandatory under MRR
- Financial incentive to report emissions as exempt
- MRR requires thorough demonstration that combusted fuel is biomass-derived fuel
- Responsibility for reporter to demonstrate conformance
- Verifier must take needed time to determine conformance, may include upstream entities

Biomass-derived Fuel Combustion Emissions: Reporters

- Reporting entities emitting ≥10,000 MT CO_2e (including CO_2 emissions from biomass-derived fuel) must report biomass derived-fuel combustion emissions (§95101(b)(4))
- Biomass-derived fuel emissions count toward the 25,000 MT CO_2e verification threshold (§95103(f))
- Emissions must be reported by fuel type unless using steam or CEMS-based methods (§95103(j))
- Emissions can be calculated using any tier

Sources that Combust Biomass-derived Fuel

- Stationary combustion sources
  - Mainly concentrated in electricity generation to meet the Renewable Portfolio Standard requirements: solid biomass, biogas, and biomethane
- Transportation fuel
  - As an oxygenate and to reduce the carbon intensity of the fuel: ethanol and bio/renewable diesel (Course 2)
- Anaerobic digesters
  - Wastewater treatment plants and landfill gas collection systems are also a source of biogas, often combusted on-site

Reporting Requirements for Biomass-derived Fuel: Solid Biomass §95103(j)(1)

- Identify if urban, agricultural, MSW, or forest-derived
  - Urban – pallets, construction waste, tree trimmings, mill residue, range land residues
  - Agricultural waste - as a result of agricultural activities such as crops, livestock, nurseries
  - MSW - solid phase waste discarded by households, commercial/retail entities, institutions (e.g., hospitals, prisons)
  - Forest derived - next slide
- If urban and agricultural biomass collected with MSW, then all identified as MSW (§95102(a))

Reporting Requirements for Biomass-derived Fuel: Forest-derived Wood and Wood Waste §95103(j)(2)

- Forest clearing and cutting, where combusted material is not a waste product from other processes (like milling)
- Report by California Forest Practice Rule (CFPR) and National Environmental Protection Act (NEPA) identifier
- Report name, address, and contact information for supplier
- High Hazard Zone (HHZ) exemptions allow some forest-derived fuels to be exempt, even without a timber harvest plan – check Guidance

Verifying Exempt Classification for Biomass: Solid and liquid fuels

- Contract review
  - Ensure proper classification and procurement timing
- Air district permit and inspection reports
  - For biomass-only plants, can give confidence that only biomass is burned
- Proper classification
  - Ensure material type has been classified consistent with definitions
  - Only need to meet forest-derived wood requirements if wood combusted is not a byproduct of other process, such as mill residue

Verifying Exempt Classification for Biomass: Forest-derived wood

- Forest-derived wood and wood waste have additional requirements
  - Review forest product reporting form. Confirm that facility received wood from said companies
  - Confirm sample of listed companies had applicable permits or exemptions and were in compliance with those permits
  - Justify sample chosen in sampling plan

Reporting Requirements for Biomass-derived Fuel: Non-exempt Biomass-derived Fuel §95103(j)(4)

- Biomass emissions are **non-exempt** if they:
  - Do not meet requirements of MRR and sections 95852.1.1 and 95852.2 of Cap-and-Trade Regulation, or
  - Cannot be verified according to the requirements of §95131(i)
- Non-exempt emissions are subject to the reporting requirements of §95103(k) and §95110-95158
  - Remember: Reporters subject to Cap-and-Trade have a compliance obligation on non-exempt emissions. Non-exempt biomass emissions must meet full fossil fuel accuracy and reporting tier requirements.

Biomass-derived Fuel Use Accuracy §95103(k)

- Fuel use accuracy is required for biomass-derived fuels when
  - CO_2 emissions trigger compliance obligation because fuel is classified as non-exempt biomass-derived
- Reported fuel usage does not need to meet +/-5% accuracy threshold if fuel is exempt, and CH_4 and N_2O are reported as de minimis
- Exception: CH_4 and N_2O emissions **from biomass**, even if not classified as de minimis, do not need to meet +/-5% accuracy threshold

Verifying Biomass GHG Emissions (1 of 4)

- For determinations using 40 CFR §98.33(e) when the biomass fraction is known and the fuel is not otherwise addressed by §95115(e)
  - Follow evidence and evaluation procedures for the applicable tier for the biomass fuel for calculating CO_2 emissions as if it were any other fuel
    - Note that pure, exempt biomass combustion can use any tier
  - If a biomass fuel is combusted with a fossil fuel in a unit monitored by a CEMS, follow the procedures in 40 CFR §98.33(e)(2) to calculate biogenic CO_2 emissions
  - Does not apply to the combustion of MSW

Verifying Biomass GHG Emissions (2 of 4)

Evidence to request and evaluate when CEMS are used:

Inputs and outputs to Eq. C-12 to C-14 in 40 CFR Part 98, Subpart C

$$V_{CO_2h} = \frac{(\%CO_2)_h}{100} \times Q_h \times t_h \quad \text{(Eq. C-12)}$$

$$\%\, Biogenic = \frac{V_{bio}}{V_{total}} \quad \text{(Eq. C-14)}$$

Verifying Biomass GHG Emissions (3 of 4)

- Evidence to request and evaluate when CEMS are used
  - For CH_4 and N_2O, fuel consumption and HHV must conform to Tier 2 (see 40 CFR §98.33(c)(1))
  - Hourly average CO_2 concentration and stack flow rate data from CEMS must conform to Tier 4 data verification and missing data requirements
  - Fuel specific carbon based F-factors must comply with Appendix G to Part 75 (see §98.33(e)(1)(iii))

Verifying Biomass GHG emissions (4 of 4)

- For determinations using 40 CFR §98.33(e) as specified in §95115(e)(1) for MSW, or other mixed fuels when biomass fraction is unknown (including when reporter elects to report biomass-derived CO_2 emissions from tires)
  - Follow verification procedures for the applicable tier for the fuel as described for determining CO_2 emissions
- For verification of the biomass-derived fraction
  - Review the sampling and analysis results of the flue gas or the fuel according to ASTM methods per 40 CFR §98.34(d)
  - Do the sampling and analysis conform to the ASTM methods and the frequency specified in 40 CFR §98.34(d)?

Verifying Exempt Classification for Biogenic CO_2 Emissions

- Request:
  - Annual and hourly heat input records
  - Purchase records, invoices, scheduling, etc. (§95131(i)(1)(B)(2))
  - Biomass specific requirements (§95131(i)(2))
- Confirm:
  - Heat input records
  - Purchase records, transportation records, chain of custody
  - Eligibility and other biomass-specific requirements are met
  - Use of correct emission factors
  - Correct calculation

Verifying Biomass GHG Determinations: Mixtures of Natural Gas and Biomethane (1 of 2)

- "Biomethane" is biogas that meets pipeline quality natural gas standards (§95102(a))
- When using Tier 2:
  - Reporters calculate separate GHG emissions from biomethane and natural gas (per §95115(e)(3))
  - Biomethane emissions are calculated from contractual deliveries
  - Verifiers follow Tier 2 verification steps for inputs and outputs used in equation in §95115(e)(3)

Verifying Biomass GHG Determinations: Mixtures of Natural Gas and Biomethane (2 of 2)

- Using Tier 4 or subject to 40 CFR §98, Subpart D
  - Reporters calculate GHG emissions from biomethane and assume the remainder are natural gas GHG emissions (§95115(e)(4))
  - Biomethane GHG emissions are calculated from contractual deliveries
  - Verifiers follow Tier 4 or Subpart D verification steps for the total GHG emissions from the mixture
  - Verifiers follow Tier 2 verification steps for the inputs and outputs used in the equation in §95115(e)(3) for the biomethane GHG emissions

Verifying Biomass GHG Determinations: Mixtures of Natural Gas and Biogas

- Mixtures require either
  - Separate metering of each fuel, or
  - Solving by difference from total and other fuel (3 variables, 2 of them are known)
- When using Tier 3, Tier 4, or subject to Subpart D
  - Reporters use Tier 3 carbon content method to determine GHG emissions from biogas; the remainder are natural gas GHG emissions (§95115(e)(5))
  - Verifiers follow applicable Tier 3 or Tier 4 verification steps for the total GHG emissions from the mixture
  - Verifiers follow Tier 3 verification steps for the biogas GHG emissions if mixture contains "covered" emissions

Reporting Requirements and Exemption for Biomethane §95103(j)(3)

- High risk - must review, even if small amount
- Reporting entity must report
  - Total biomethane consumption and exemption status
  - Name and address of biomethane vendor(s) and MMBtu delivered by each vendor
  - Name, address and facility type where biomethane is produced (§95103(j)(3))
- Must have documentation to demonstrate eligibility
  - Contract for actual biomethane, consistent with C&T §95852.1.1
  - Invoices for purchase
  - Shipping reports
  - Allocation, balancing, and nomination reports
- Document your approach in sampling plan
- Must be reported as non-exempt natural gas if reporter cannot provide evidence of applicability and accuracy

Sample Calculations of CO_2 Emissions Group Participation Exercise 1.2.4

- Scenario
  - Fuel: Municipal Solid Waste
  - Steam generation: 3 x 10^9 lbs per year
  - B-ratio: 0.0016 MMBtu maximum rated heat input/lb of steam output capacity
  - Results of ASTM analysis of emissions: 62% of emissions are biogenic
- What are the annual fossil fuel CO_2 emissions?

  A. 435,360 MT CO_2/yr

  B. 269,923 MT CO_2/yr

  C. 165,437 MT CO_2/yr

Sample Calculations of CO_2 Emissions Group Participation Exercise 1.2.4 Solution

The correct answer is C: **165,437 MT CO_2/yr fossil based emissions**

Step 1: Calculate total CO_2 emissions using Eq. C-2c, and correct CO_2 EF from Table C-1 of 90.7 kg CO_2/MMBtu :

$$CO_2 = 1 \times 10^{-3} \times B \times Steam \times EF$$

1×10^{-3} MT/kg x 0.0016 MMBtu/lb x 3×10^9 lb/yr x 90.7 kg CO_2/MMBtu

$$= 435{,}360 \text{ MT } CO_2/yr$$

Step 2: Calculate biogenic CO_2 emissions:

435,360 MT CO_2/yr x 0.62 MT biogenic CO_2/MT total CO_2 = 269,923 MT CO_2/yr

Step 3: Subtract biogenic CO_2 from total CO_2 to determine fossil-based emissions:

435,360 MT CO_2/yr - 269,923 MT CO_2/yr = 165,437 MT CO_2/yr

Course 1: General Verification

Complete:

- 1.1 Verification Principles, Requirements, and Procedures
- 1.2 Stationary Fuel Combustion and Sorbent Sources

Next:

- 1.3 Accuracy and Product Data
- 1.4 Electricity Generating Units and Cogeneration