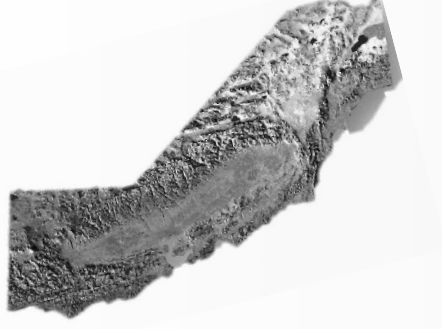


Verifier Accreditation Training for Mandatory GHG Reporting

General Verification

Course 1.4 - Electricity Generating Units and Cogeneration



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**

2

Course 1.4 Handouts

- 1.4.1 Energy Disposition
- 1.4.2 Sample Cogeneration Emissions Data Report
- 1.4.3 Comprehensive Case Study

3

Course 1.4 Electricity Generating Units and Cogeneration

- 1. Applicability**
2. Data to Report
3. Electricity Generating Units
4. Verifying Emissions Data
5. Group Participation Exercises

4

MRR §95112 - Applicability

- Facilities subject to MRR with Electricity Generating Units (EGUs)
 - Must follow §95112 for EGUs if ≥ 1 MW
 - When total nameplate generating capacity < 1 MW, must report, but may elect to follow §95115 and report EGUs as stationary fuel combustion
 - Other (non-EGU) SFC sources report under §95115



5

Facility Types Reporting under §95112

- EGUs that are subject to the requirements of the Acid Rain Program and 40 CFR Part 75
- Geothermal electricity generating facilities
- EGUs include cogeneration and bi-generation units, as well as facilities that generate only electricity and no steam
- Hydrogen Fuel Cells
- Exclusion
 - Electricity generating facilities that are solely powered by nuclear, hydroelectric, wind, or solar power with stationary fuel combustion emissions $< 10,000$ MT CO_{2e}

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Course 1.4 Electricity Generating Units and Cogeneration

1. Applicability
2. **Data to Report**
 - **Information to Report**
 - **Methods to Calculate Emissions**
 - **Energy Data Reporting**
3. Electricity Generating Units
4. Verifying Emissions Data
5. Group Participation Exercises

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Data Reported by Facility/EGU

- Unit ID number (CEC, EPA, etc.)
- Nameplate generating capacity by unit
- Type of facility
- Disposition of generated electricity
 - Provided to retail provider or marketer who distributes over the grid (name of provider/marketer)
 - Provided or sold directly to particular end-users (customers)
 - If applicable, amount of electricity used by industrial processes/operations on site

8

Emissions Reporting

- Section 95112 requires reporting of:
 - CO₂, CH₄, and N₂O emissions reported by fuel type for each EGU (or aggregated group of EGUs) subject to reporting
 - Information about the electricity generating facility and units (§95112(a) and (b))
 - CO₂ and CH₄ emissions from geothermal facilities (§95112(e))
 - CO₂ emissions from hydrogen fuel cells (§95112(f))
 - On-site renewable electricity generation (§95112(g))

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Methods to Calculate Emissions

- Operators subject to 40 CFR Part 98 Subpart C
 - Use a method from 40 CFR §98.33(a)(1-4) – Tiers
 - As specified by fuel type in §95115
- Operators subject to 40 CFR Part 98 Subpart D
 - May report CO₂ emissions using 40 CFR §98.43
 - Limited by §95103(m)

Methods to Calculate Emissions

- Facilities/Units Subject to 40 CFR Part 75 are given a choice to report either
 - Under 40 CFR Part 75 (Subpart D)
 - Fuel-based methodology (40 CFR §75.13(b) and Appendix G, Section 2.3, Eq. G-4), or
 - CO₂ or O₂ monitors (40 CFR §75.13(a)-(c))
- or**
- Under 40 CFR Part 98 (Subpart C)
 - Applicable 40 CFR Part 98 (Tier) methods may be used (§95112(c)) – subject to the limitations in §95103(m) for changing methods

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Methods to Calculate Emissions - Geothermal Facilities/Units

- Source-specific emission factors derived from a CARB approved measurement plan (§95112(e))
 - Identify open vs closed loop



Energy Data Reported Under §95112

- Disposition of generated electricity and thermal energy (§95112(a)(4-5))
- Block diagram of equipment, energy flows, and meter locations (§95112(a)(6))
- For cogeneration or bigeneration units, total thermal output generated by the unit that can be potentially utilized in other industrial operations that are not electricity generation (§95112(b)(3))
- Detailed reporting of steam or heat acquired from external sources for power generation (§95112(b)(8))
- For bottoming cycle cogeneration units only, also report input steam to the steam turbine and the output of the heat recovery steam generator (§95112(b)(8))

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Course 1.4 Electricity Generating Units and Cogeneration

1. Applicability
2. Data to Report
3. **Electricity Generating Units**
 - **Statistics on Units Subject to Verification**
 - **Boundaries**
 - **Types**
 - **System Energy Accounting**
4. Verifying Emissions Data
5. Group Participation Exercises

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Electricity Generating Facilities/Units Subject to Verification

- A lot of electricity generating plants in California!
 - 127 stand-alone power plants
 - 118 industrial/institutional/commercial facilities
 - Oil and gas, universities, paper manufacturing, landfills, etc.
 - 19 independently operated cogeneration and bigeneration facilities
- Fuel is mostly natural gas, with some biomass-derived fuel, refinery fuel gas, and several geothermal plants

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Facility Boundary §95112(a)(3)

- Stand-alone - Independently operated and sited facility
 - Only emissions within facility boundary are reported
- Industrial/institutional/commercial electricity generating facility
 - Emissions from adjacent or co-located thermal host included in the facility boundary if shared operational control
 - Emissions from non-adjacent thermal host not included

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Types of Cogeneration Facilities/Units

- Approximately 127 electricity-only power plants (not cogeneration, but includes combined cycle)
- 89 topping cycle cogeneration facilities
 - Oil and gas, hospitals, universities, food processing, lumber mills, and refineries
- 4 bottoming cycle cogeneration facilities
 - Hydrogen production
 - Calciners
 - Chemical production facility

Updated from 2020 training. See errata.

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Thermal Energy Generation Data

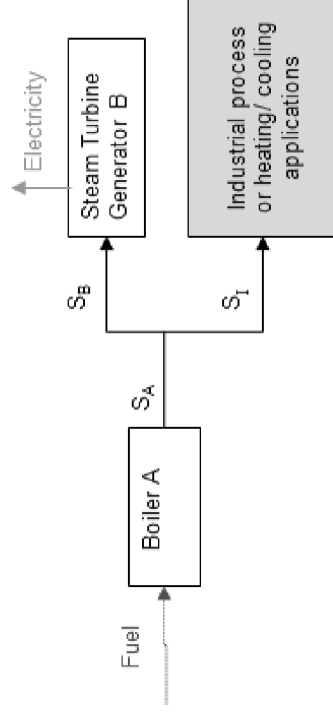
Video of cogeneration (1 minute 20 seconds)

<http://www.youtube.com/watch?v=dRqgUCLjmqE>

18

Bigeneration §95112(a)(3) and (b)(1)(D)

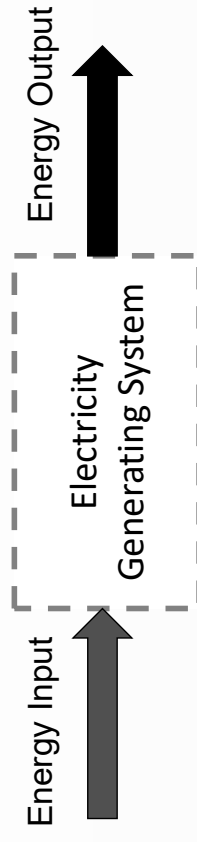
EGU that simultaneously produces electricity and steam from the same fuel source but does not utilize waste heat



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System Energy Accounting (1 of 2)

“System boundary” is the foundation for determining what energy quantities are to be reported under §95112(a) and (b)



The difference between energy input and energy output is waste energy (e.g., vented steam and mechanical friction)

20

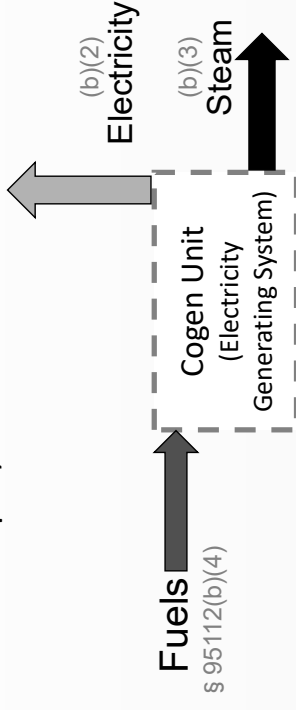
System Energy Accounting (2 of 2)

- §95112(a): Indicates where the generated energy flows go after they leave the system
- §95112(b): Accounts for the energy inputs and outputs of the EGU or the electricity generating system
- To ensure the system energy balance is completely accounted for, a system energy diagram is critical

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Simplified Block Diagram §95112(a)(6)

- Equipment associated with the electricity generating system, and any equipment or industrial processes outside of the system that may inform energy flows
- Flows of energy (fuel input, electricity output, thermal output) shown with arrows and labels



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System Approach

- Reporters aggregate the individual units in an electricity generating system (EGS) if the units are integrated
- Types of systems
 - Cogeneration system
 - Bigeneration system
 - Combined-cycle electricity generation system
 - System of boilers producing steam to power steam turbine generators
- Auxiliary or stand-by boilers
 - If the boiler does not contribute to electricity generation (boiler steam feeds a steam turbine generator), report it separately under subpart C

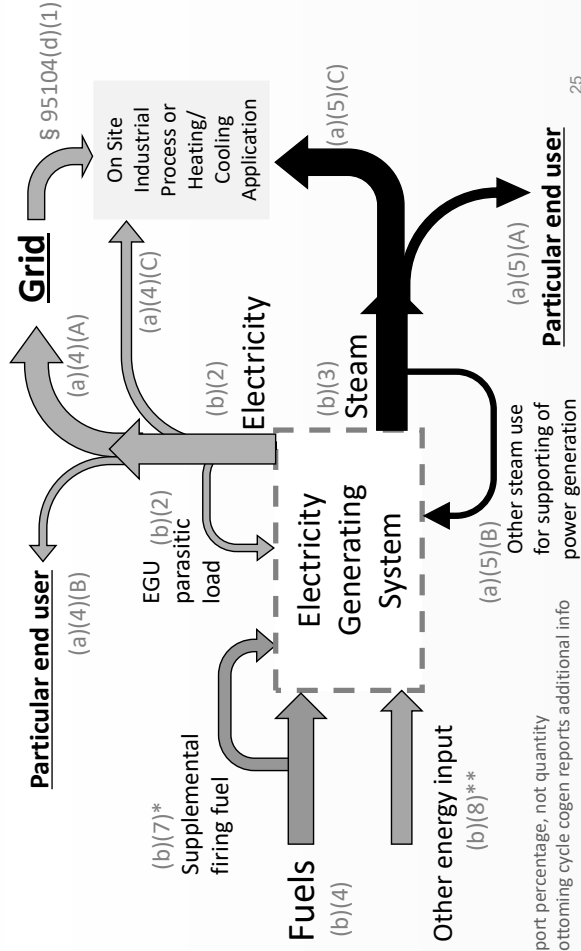
23

Data Reported by Cogeneration or Bigeneration Unit

- Thermal energy provided or sold to another end-user
- If applicable, amount of thermal energy used by industrial processes/operations on site not used to generate additional electricity
- Thermal energy excludes steam that is used for power production (e.g., steam used to drive a steam turbine generator)

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Cogeneration System Energy Accounting



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Total Thermal Output (2 of 2)

$$\text{The Sum: } \begin{cases} \$ 95112(a)(5)(A) \\ \$ 95112(a)(5)(B) \\ \$ 95112(a)(5)(C) \end{cases} \leq \$ 95112(b)(3)$$

- The difference between the two sides of the comparison is the thermal energy that was generated by cogen/bigen units but was not utilized for any useful purpose (e.g., vented steam)
- Include only thermal energy generated by a cogen/bigen system in these quantities
- Engineering estimation is acceptable

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Total Thermal Output (1 of 2)

- Total amount of usable thermal energy that can potentially be made available for use in industrial/commercial processes, heating/cooling applications, or delivered to other end users. It includes
 - Steam sold §95112(a)(5)(A). Thermal energy provided or sold to a particular end-user
 - Parasitic Steam Use §95112(a)(5)(B). Thermal energy used for supporting power generation that has been included in the §95112(b)(3) quantity but is not accounted for in either §95112(a)(5)(A) or (C)
 - Steam for Industrial Use §95112(a)(5)(C). Thermal energy used in other on-site industrial processes or heating/cooling applications that are not electricity generation
 - Thermal energy that is vented, radiated, or otherwise wasted
- Does not include steam to make more electricity

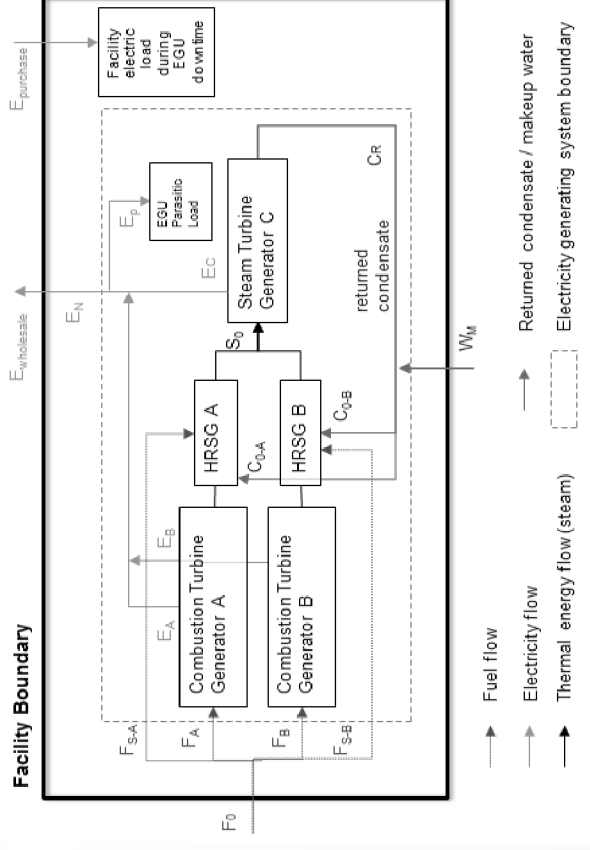
26

Cooling Energy §95112(a)(4)(C) and (a)(5)(C)

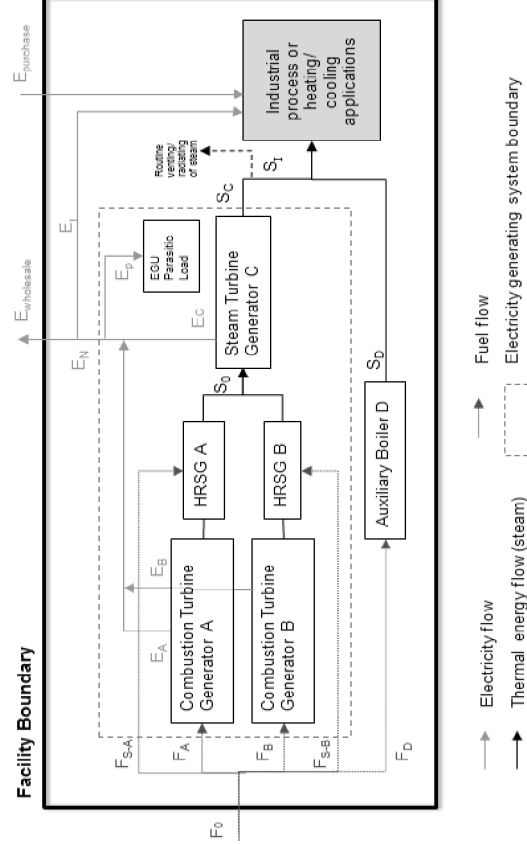
- Cogeneration operator must estimate and report electricity and thermal energy related to cooling energy (e.g., chilled water) if
- Provided to end user outside of facility boundary or
 - Used for an on-site industrial process that is not part of electricity generation

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Example of Combined Cycle Electricity Generating Facility



Example of Topping Cycle Cogen and Separate Aux Boiler



Electricity Generation Data

Gross vs. net generation (Example for previous slide)

\$95112	Item Description	Quantity
(a)(4)(A)	Generated electricity provided to wholesale (grid)	$E_{\text{wholesale}}$
(a)(4)(B)	Generated electricity provided or sold directly to particular end-user	0
(a)(4)(C)	Generated electricity used by on-site industrial processes or operations that are neither in support of or a part of the power generation system	E_i
(a)(5)(A)	Generated thermal energy provided or sold to particular end-user	0
(a)(5)(B)	Generated thermal energy for supporting power production	0
(a)(5)(C)	Generated thermal energy used by on-site industrial processes or operations (exclude any wasted energy)	S_i
(b)(2)	Gross generation	$E_A + E_B + E_C$
(b)(2)	Net generation	$E_N = (E_A + E_B + E_C) - E_P$

Course 1.4 Electricity Generating Units and Cogeneration

1. Applicability
2. Data to Report
3. Electricity Generating Units
4. **Verifying Emissions Data**
5. Group Participation Exercises

Verifying Electricity Generation and Disposition

- Evidence to request
 - Electricity generation and disposition measurement records
 - In the absence of an electricity meter, other records used to develop an engineering estimate
 - Facility meter layout and uses
 - CEC 1304 forms (use as a cross-check; not as primary data)
- How to examine evidence
 - Examine electricity generation and disposition records for completeness and accuracy
 - Review and confirm reasonableness of any engineering estimates
 - Confirm what is reported as net and gross generation is consistent with the applicable definitions

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Verifying Thermal Energy Production and Disposition

- Evidence to request
 - Thermal energy production and disposition measurement records
 - In the absence of a steam meter, other records used to develop an engineering estimate
- How to examine evidence
 - Examine thermal energy production and disposition records for completeness and reasonable accuracy
 - Review and confirm reasonableness of any engineering estimates

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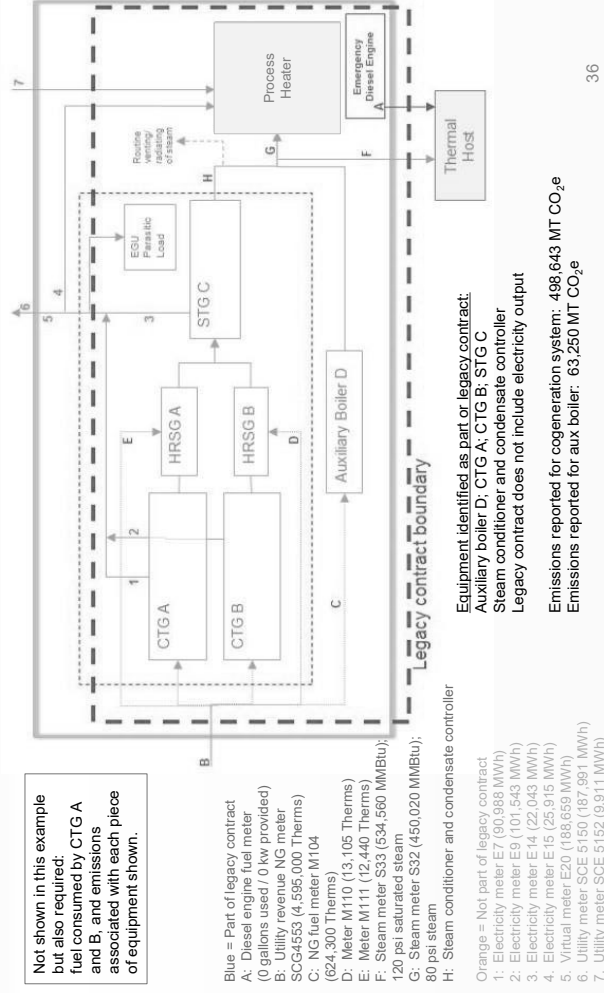
Verifiers are Required to Review Energy Generation and Disposition if...§95131(b)(8)(F)

- The facility belongs to an industrial sector listed in Table 8-1 of the Cap-and-Trade Regulation;
- The operator is applying for legacy contract transition assistance under the Cap-and-Trade Regulation; or
- The operator has applied for the limited exemption of emissions from the production of qualified thermal output pursuant to the Cap-and-Trade Regulation. *

*A complete list of “but-for” entities reporting QTO is on page 14 of the Vintage 2015 Allowance Allocation report.

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Legacy Contract Assistance Block Diagram



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General Errors made by EGUs Identified by Verifiers

- Inadequate cogen block diagram
- Incorrectly aggregated types of emission sources
- Incomplete GHG Monitoring Plan
- Incorrect emission factors and calculation methods
- Small sources not reported
- Improper use of missing data
- Fuel bill was not pro-rated
- Monthly fuel sampling not conducted
- Incorrect biomass fuel classification (urban, ag, forest-derived)

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Course 1.4 Electricity Generating Units and Cogeneration

1. Applicability
2. Data to Report
3. Electricity Generating Units
4. Verifying Emissions Data
5. **Group Participation Exercises**

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Group Participation Exercise 1.4.1: Determining §95112 Applicability

- Given the following three facilities
 - A. EGU subject to the Acid Rain Program
 - B. Nuclear power plant with diesel-fired emergency generators that emitted 15,000 MT CO₂e
 - C. Geothermal generating facility emitting 14,000 MT CO₂e
- Which of the facilities are subject to reporting under §95112?
 - A only
 - A and B
 - A and C
 - All of the above

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Group Participation Exercise 1.4.1: Determining §95112 Applicability - Solution

- Given the following three facilities
 - A. EGU subject to the Acid Rain Program
 - B. Nuclear power plant with diesel-fired emergency generators that emitted 15,000 MT CO₂e
 - C. Geothermal generating facility emitting 14,000 MT CO₂e
- Which of the facilities are subject to reporting under §95112?
 - A only
 - A and B
 - A and C
 - All of the above

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Group Participation Exercise 1.4.2: Determining Tier 4 Applicability

Which of these facilities must use the Tier 4 Methodology from 40 CFR §98.33 to calculate CO₂ combustion emissions?

- A. Facility not subject to 40 CFR Part 75
- B. Facility not subject to 40 CFR Part 75 and required by air district to operate CO₂ CEMS
- C. Facility subject to 40 CFR Part 75

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Group Participation Exercise 1.4.2: Determining Tier 4 Applicability - Solution

Which of these facilities must use the Tier 4 Methodology from 40 CFR §98.33 to calculate CO₂ combustion emissions?

- A. Facility not subject to 40 CFR Part 75
- B. Facility not subject to 40 CFR Part 75 and required by air district to operate CO₂ CEMS
- C. Facility subject to 40 CFR Part 75

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Group Participation Exercise 1.4.2: Determining Tier 4 Applicability

Which of these facilities must use the Tier 4 Methodology from 40 CFR §98.33 to calculate CO₂ combustion emissions?

- A. Facility not subject to 40 CFR Part 75
- B. Facility not subject to 40 CFR Part 75 and required by air district to operate CO₂ CEMS
- C. Facility subject to 40 CFR Part 75

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Group Participation Exercise 1.4.2: Determining Tier 4 Applicability - Solution

Which of these facilities must use the Tier 4 Methodology from 40 CFR §98.33 to calculate CO₂ combustion emissions?

- A. Facility not subject to 40 CFR Part 75
- B. Facility not subject to 40 CFR Part 75 and required by air district to operate CO₂ CEMS
- C. Facility subject to 40 CFR Part 75

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Group Participation Exercise 1.4.3: Cogeneration Facility Reporting

○ A facility with a topping cycle cogeneration unit provides steam to an off-site thermal host. The facility also operates a separate simple cycle natural gas turbine that is subject to 40 CFR Part 75. The turbine represents 28% of the annual emissions.

- Under which subpart(s) should emissions be reported?
 - Subpart C
 - Subpart D
 - Subparts C and D
 - None of the above

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Group Participation Exercise 1.4.3: Cogeneration Facility Reporting - Solution

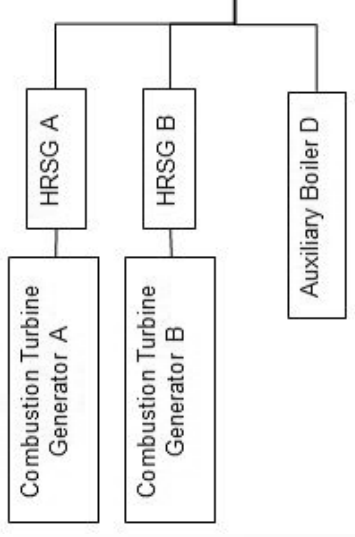
○ A facility with a topping cycle cogeneration unit provides steam to an off-site thermal host. The facility also operates a separate simple cycle natural gas turbine that is subject to 40 CFR Part 75. The turbine represents 28% of the annual emissions.

- Under which subpart(s) should emissions be reported?
 - Subpart C
 - Subpart D
 - Subparts C and D
 - None of the above

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Group Participation Exercise 1.4.4: Energy Disposition

See Handouts 1.4.1: Energy Disposition and 1.4.2: Sample Cogeneration Emissions Data Report



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Comprehensive Case Study

- Handout 1.4.3, Comprehensive Case Study (Moo Cow) with recommendations and answers
- Prepare a sampling plan based on Cal e-GGRT report sample
- Facility producing butter and cheese

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