§ 98.442 GHGs to report.

You must report:

(a) Mass of CO₂ received.

(b) Mass of CO₂ injected into the subsurface.

(c) Mass of CO₂ produced.

(d) Mass of CO₂ emitted by surface leakage.

(e) Mass of CO₂ equipment leakage and vented CO₂ emissions from surface equipment located between the injection flow meter and the injection wellhead.

(f) Mass of CO₂ equipment leakage and vented CO₂ emissions from surface equipment located between the production flow meter and the production wellhead.

(g) Mass of CO₂ sequestered in subsurface geologic formations.

(h) Cumulative mass of CO₂ reported as sequestered in subsurface geologic formations in all years since the facility became subject to reporting requirements under this subpart.

§ 98.443 Calculating CO₂ geologic sequestration.

You must calculate the mass of CO₂ received using CO₂ received equations (Equations RR-1 to RR-3 of this section), unless you follow the procedures in §98.444(a)(4). You must calculate CO₂ sequestered using injection equations (Equations RR-4 to RR-6 of this section), production/recycling equations (Equations RR-7 to RR-9 of this section), surface leakage equations (Equation RR-10 of this section), and sequestration equations (Equations RR-11 and RR-12 of this section). For your first year of reporting, you must calculate CO₂ sequestered starting from the date set forth in your approved MRV plan.

(a) You must calculate and report the annual mass of CO₂ received by pipeline using the procedures in paragraphs (a)(1) or (a)(2) of this section and the procedures in paragraph (a)(3) of this section, if applicable.

(1) For a mass flow meter, you must calculate the total annual mass of CO₂ in a CO₂ stream received in metric tons by multiplying the mass flow by the CO₂ concentration in the flow, according to Equation RR-1 of this section. You must collect these data quarterly. Mass flow and concentration data measurements must be made in accordance with §98.444.

\[
\text{CO}_2 \text{T.r} = \sum_{p=1}^{4} (Q_{r,p} - S_{r,p}) \times C_{\text{CO}_2 \text{r,p}}
\]

(Eq. RR-1)

Where:

\(\text{CO}_2 \text{T.r} = \) Net annual mass of CO₂ received through flow meter r (metric tons).

\(Q_{r,p} = \) Quarterly mass flow through a receiving flow meter r in quarter p (metric tons).

\(S_{r,p} = \) Quarterly mass flow through a receiving flow meter r that is redelivered to another facility without being injected into your well in quarter p (metric tons).
C_{CO_2,p,r} = Quarterly CO_2 concentration measurement in flow for flow meter r in quarter p (wt. percent CO_2, expressed as a decimal fraction).
p = Quarter of the year.
r = Receiving flow meter.

(2) For a volumetric flow meter, you must calculate the total annual mass of CO_2 in a CO_2 stream received in metric tons by multiplying the volumetric flow at standard conditions by the CO_2 concentration in the flow and the density of CO_2 at standard conditions, according to Equation RR–2 of this section. You must collect these data quarterly. Volumetric flow and concentration data measurements must be made in accordance with §98.444.

$$CO_{2T,r} = \sum_{p=1}^{4} (Q_{r,p} - S_{r,p}) * D * C_{CO_2,p,r} \quad \text{(Eq. RR–2)}$$

Where:
- $CO_{2T,r}$ = Net annual mass of CO_2 received through flow meter r (metric tons).
- $Q_{r,p}$ = Quarterly volumetric flow through a receiving flow meter r in quarter p at standard conditions (standard cubic meters).
- $S_{r,p}$ = Quarterly volumetric flow through a receiving flow meter r that is redelivered to another facility without being injected into your well in quarter p (standard cubic meters).
- $D$ = Density of CO_2 at standard conditions (metric tons per standard cubic meter): 0.0018682.
- $C_{CO_2,p,r}$ = Quarterly CO_2 concentration measurement in flow for flow meter r in quarter p (vol. percent CO_2, expressed as a decimal fraction).

(3) If you receive CO_2 through more than one flow meter, you must sum the mass of all CO_2 received in accordance with the procedure specified in Equation RR–3 of this section.

$$CO_2 = \sum_{r=1}^{R} CO_{2T,r} \quad \text{(Eq. RR–3)}$$

Where:
- $CO_2$ = Total net annual mass of CO_2 received (metric tons).
- $CO_{2T,r}$ = Net annual mass of CO_2 received (metric tons) as calculated in Equation RR–1 or RR–2 for flow meter r.
- $r$ = Receiving flow meter.

(b) You must calculate and report the annual mass of CO_2 received in containers using the procedures in paragraphs (b)(1) or (b)(2) of this section.

(1) If you are measuring the mass of contents in a container under the provisions of §98.444(a)(2)(i), you must calculate the CO_2 received for injection in containers using Equation RR–1 of this section.

Where:
- $CO_{TR,r}$ = Net annual mass of CO_2 received in containers r (metric tons).
- $Q_{r,p}$ = Quarterly mass of contents in containers r in quarter p (metric tons).
- $S_{r,p}$ = Quarterly mass of contents in containers r redelivered to another facility without being injected into your well in quarter p (metric tons).
- p = Quarter of the year.
- r = Containers.

(2) If you are measuring the volume of contents in a container under the provisions of §98.444(a)(2)(ii), you must calculate the CO_2 received for injection in containers using Equation RR–2 of this section.

Where:
- $CO_{C,r}$ = Quarterly CO_2 concentration measurement of contents in containers r in quarter p (vol. percent CO_2, expressed as a decimal fraction).
- $Q_{r,p}$ = Quarterly mass of contents in containers r in quarter p (metric tons).
- $S_{r,p}$ = Quarterly mass of contents in containers r redelivered to another facility without being injected into your well in quarter p (metric tons).
- p = Quarter of the year.
- r = Containers.
§ 98.443

(c) You must report the annual mass of CO₂ injected in accordance with the procedures specified in paragraphs (c)(1) through (c)(3) of this section.

(1) If you use a mass flow meter to measure the flow of an injected CO₂ stream, you must calculate annually the total mass of CO₂ (in metric tons) in the CO₂ stream injected each year in metric tons by multiplying the mass flow by the CO₂ concentration in the flow, according to Equation RR–4 of this section. Mass flow and concentration data measurements must be made in accordance with §98.444.

\[
\text{CO}_2, u = \sum_{p=1}^{4} Q_{p,u} \ast C_{\text{CO}_2,p,u} \quad \text{(Eq. RR–4)}
\]

Where:
\(\text{CO}_2,u\) = Annual CO₂ mass injected (metric tons) as measured by flow meter u.
\(Q_{p,u}\) = Quarterly mass flow rate measurement for flow meter u in quarter p (metric tons per quarter).
\(C_{\text{CO}_2,p,u}\) = Quarterly CO₂ concentration measurement in flow for flow meter u in quarter p (wt. percent CO₂, expressed as a decimal fraction).
\(p\) = Quarter of the year.
\(u\) = Flow meter.

(2) If you use a volumetric flow meter to measure the flow of an injected CO₂ stream, you must calculate annually the total mass of CO₂ (in metric tons) in the CO₂ stream injected each year in metric tons by multiplying the volumetric flow at standard conditions by the CO₂ concentration in the flow and the density of CO₂ at standard conditions, according to Equation RR–5 of this section. Volumetric flow and concentration data measurements must be made in accordance with §98.444.

\[
\text{CO}_2, u = \sum_{p=1}^{4} Q_{p,u} \ast D \ast C_{\text{CO}_2,p,u} \quad \text{(Eq. RR–5)}
\]

Where:
\(\text{CO}_2,u\) = Annual CO₂ mass injected (metric tons) as measured by flow meter u.
\(Q_{p,u}\) = Quarterly volumetric flow rate measurement for flow meter u in quarter p at standard conditions (standard cubic meters per quarter).
\(D\) = Density of CO₂ at standard conditions (metric tons per standard cubic meter): 0.0018682.
\(C_{\text{CO}_2,p,u}\) = CO₂ concentration measurement in flow for flow meter u in quarter p (vol. percent CO₂, expressed as a decimal fraction).
\(p\) = Quarter of the year.
\(u\) = Flow meter.

(3) To aggregate injection data for all wells covered under this subpart, you must sum the mass of all CO₂ injected through all injection wells in accordance with the procedure specified in Equation RR–6 of this section.
Where:

\[ \text{CO}_{2I} = \sum_{u=1}^{U} \text{CO}_{2,u} \]  
(Eq. RR–6)

\[ \text{CO}_{2,w} = \sum_{p=1}^{4} Q_{p,w} \times C_{\text{CO}_{2,p,w}} \]  
(Eq. RR–7)

\[ \text{CO}_{2,w} = \sum_{p=1}^{4} Q_{p,w} \times D \times C_{\text{CO}_{2,p,w}} \]  
(Eq. RR–8)

(1) For each gas-liquid separator for which flow is measured using a mass flow meter, you must calculate annually the total mass of \( \text{CO}_2 \) produced from an oil or other fluid stream in metric tons that is separated from the fluid by multiplying the mass flow by the \( \text{CO}_2 \) concentration in the gas stream, according to Equation RR–7 of this section. You must collect these data quarterly. Mass flow and concentration data measurements must be made in accordance with §98.444.

(2) For each gas-liquid separator for which flow is measured using a volumetric flow meter, you must calculate annually the total mass of \( \text{CO}_2 \) produced from an oil or other fluid stream in metric tons that is separated from the fluid by multiplying the volumetric gas flow at standard conditions by the \( \text{CO}_2 \) concentration in the gas flow and the density of \( \text{CO}_2 \) at standard conditions, according to Equation RR–8 of this section. You must collect these data quarterly. Volumetric flow and concentration data measurements must be made in accordance with §98.444.

(3) To aggregate production data, you must sum the mass of all of the \( \text{CO}_2 \) separated at each gas-liquid separator that was injected into the well or wells covered by this source category.
in accordance with the procedure specified in Equation RR-9 of this section. You must assume that the total CO₂ measured at the separator(s) represents a percentage of the total CO₂ produced. In order to account for the percentage of CO₂ produced that is estimated to remain with the produced oil or other fluid, you must multiply the quarterly mass of CO₂ measured at the separator(s) by a percentage estimated using a methodology in your approved MRV plan.

\[
CO_{2P} = (1+X) \times \sum_{w=1}^{W} CO_{2,w} \quad \text{(Eq. RR-9)}
\]

Where:
- \(CO_{2P}\) = Total annual CO₂ mass produced (metric tons) through all separators in the reporting year.
- \(CO_{2,w}\) = Annual CO₂ mass produced (metric tons) through separator \(w\) in the reporting year.
- \(X\) = Entrained CO₂ in produced oil or other fluid divided by the CO₂ separated through all separators in the reporting year (weight percent CO₂, expressed as a decimal fraction).
- \(W\) = Separator.

(e) You must report the annual mass of CO₂ that is emitted by surface leakage in accordance with your approved MRV plan. You must calculate the total annual mass of CO₂ emitted from all leakage pathways in accordance with the procedure specified in Equation RR-10 of this section.

\[
CO_{2E} = \sum_{x=1}^{X} CO_{2,x} \quad \text{(Eq. RR-10)}
\]

Where:
- \(CO_{2E}\) = Total annual CO₂ mass emitted by surface leakage (metric tons) in the reporting year.
- \(CO_{2,x}\) = Annual CO₂ mass emitted (metric tons) at leakage pathway \(x\) in the reporting year.
- \(X\) = Leakage pathway.

(f) You must report the annual mass of CO₂ that is sequestered in subsurface geologic formations in the reporting year in accordance with the procedures specified in paragraphs (f)(1) and (f)(2) of this section.

(1) If you are actively producing oil or natural gas or if you are producing any other fluids, you must calculate the annual mass of CO₂ that is sequestered in the underground subsurface formation in the reporting year in accordance with the procedure specified in Equation RR-11 of this section.

\[
CO_{2} = CO_{2I} - CO_{2P} - CO_{2E} - CO_{2FI} - CO_{2FP} \quad \text{(Eq. RR-11)}
\]

Where:
- \(CO_{2}\) = Total annual CO₂ mass produced (metric tons) in the reporting year.
- \(CO_{2P}\) = Total annual CO₂ mass produced (metric tons) through all separators in the reporting year.
- \(CO_{2E}\) = Total annual CO₂ mass emitted (metric tons) by surface leakage in the reporting year.
- \(CO_{2FI}\) = Total annual CO₂ mass emitted (metric tons) as equipment leakage or vented emissions from equipment located on the surface between the flow meter used to
measure injection quantity and the injection wellhead, for which a calculation procedure is provided in subpart W of this part.

\( \text{CO}_2 \, \text{FP} = \text{Total annual CO}_2 \text{ mass emitted (metric tons) as equipment leakage or vented emissions from equipment located on the surface between the production wellhead and the flow meter used to measure production quantity, for which a calculation procedure is provided in subpart W of this part.} \)

(2) If you are not actively producing oil or natural gas or any other fluids, you must calculate the annual mass of \( \text{CO}_2 \) that is sequestered in subsurface geologic formations in the reporting year in accordance with the procedures specified in Equation RR–12 of this section.

\[
\text{CO}_2 = \text{CO}_2 \, \text{FI} - \text{CO}_2 \, \text{E} \quad \text{(Eq. RR–12)}
\]

Where:

- \( \text{CO}_2 \) = Total annual \( \text{CO}_2 \) mass sequestered in subsurface geologic formations (metric tons) at the facility in the reporting year.
- \( \text{CO}_2 \, \text{FI} \) = Total annual \( \text{CO}_2 \) mass injected (metric tons) in the well or group of wells covered by this source category in the reporting year.
- \( \text{CO}_2 \, \text{E} \) = Total annual \( \text{CO}_2 \) mass emitted (metric tons) by surface leakage in the reporting year.
- \( \text{CO}_2 \, \text{FI} \) = Total annual \( \text{CO}_2 \) mass emitted (metric tons) as equipment leakage or vented emissions from equipment located on the surface between the flow meter used to measure injection quantity and the injection wellhead.

§ 98.444 Monitoring and QA/QC requirements.

(a) \( \text{CO}_2 \) received.

(1) Except as provided in paragraph (a)(4) of this section, you must determine the quarterly flow rate of \( \text{CO}_2 \) received by pipeline by following the most appropriate of the following procedures:

(i) You may measure flow rate at the receiving custody transfer meter prior to any subsequent processing operations at the facility and collect the flow rate quarterly.

(ii) If you took ownership of the \( \text{CO}_2 \) in a commercial transaction, you may use the quarterly flow rate data from the sales contract if it is a one-time transaction or from invoices or manifests if it is an ongoing commercial transaction with discrete shipments.

(iii) If you inject \( \text{CO}_2 \) received from a production process unit that is part of your facility, you may use the quarterly \( \text{CO}_2 \) flow rate that was measured at the equivalent of a custody transfer meter following procedures provided in subpart PP of this part. To be the equivalent of a custody transfer meter, a meter must measure the flow of \( \text{CO}_2 \) being transported to an injection well to the same degree of accuracy as a meter used for commercial transactions.

(2) Except as provided in paragraph (a)(4) of this section, you must determine the quarterly mass or volume of contents in all containers if you receive \( \text{CO}_2 \) in containers by following the most appropriate of the following procedures:

(i) You may measure the mass of contents of containers summed quarterly using weigh bills, scales, or load cells.

(ii) You may determine the volume of the contents of containers summed quarterly.

(iii) If you took ownership of the \( \text{CO}_2 \) in a commercial transaction for which the sales contract was contingent on receipt, you may measure the quarterly mass or volume of contents of containers if you received \( \text{CO}_2 \) in containers by following the most appropriate of the following procedures:

(i) You may sample the \( \text{CO}_2 \) stream at least once per quarter at the point of receipt and measure its \( \text{CO}_2 \) concentration.

(ii) If you took ownership of the \( \text{CO}_2 \) in a commercial transaction for which the sales contract was contingent on