Refresher on the Mass-Balance Approach: Principles and Application

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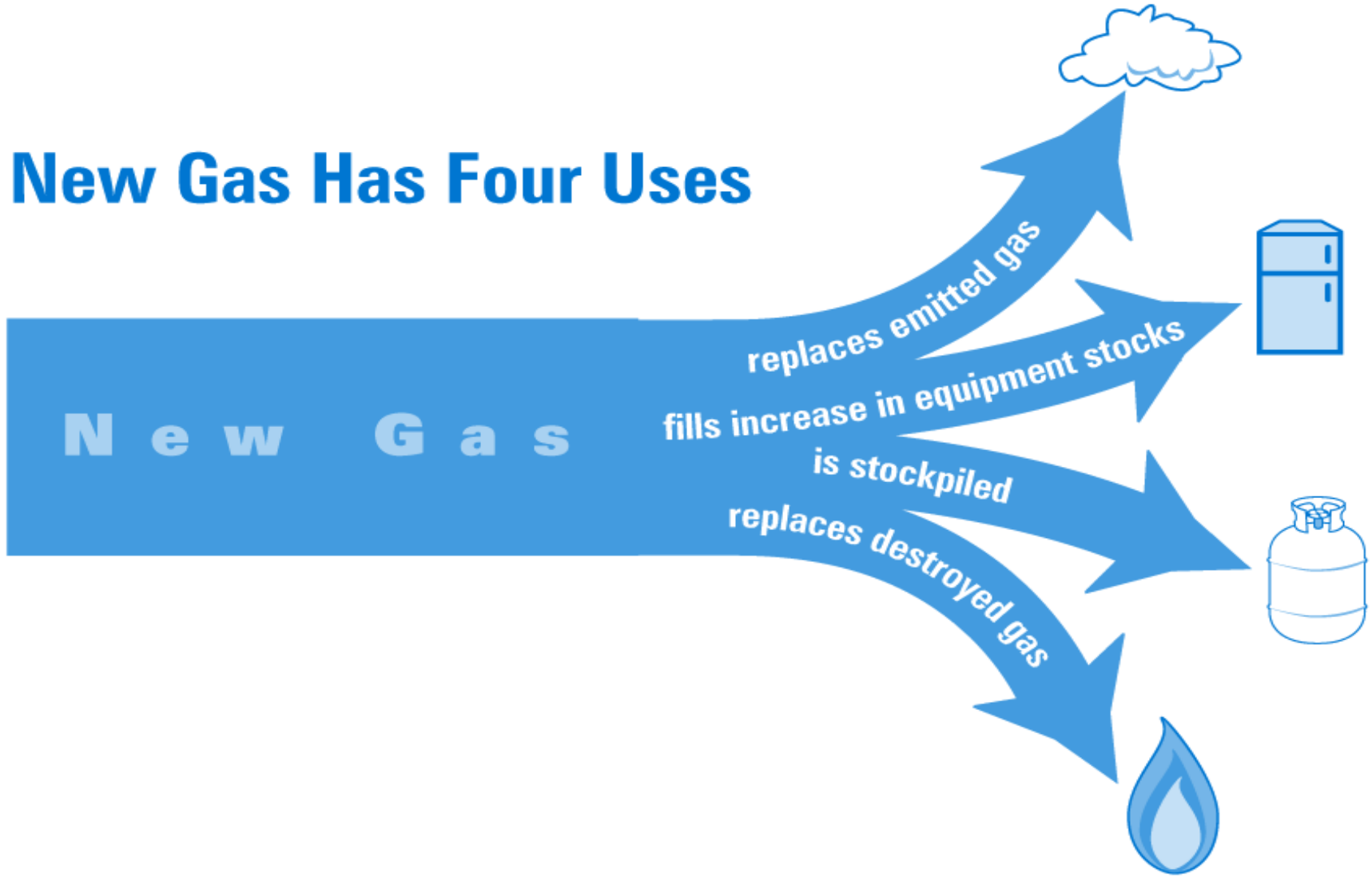
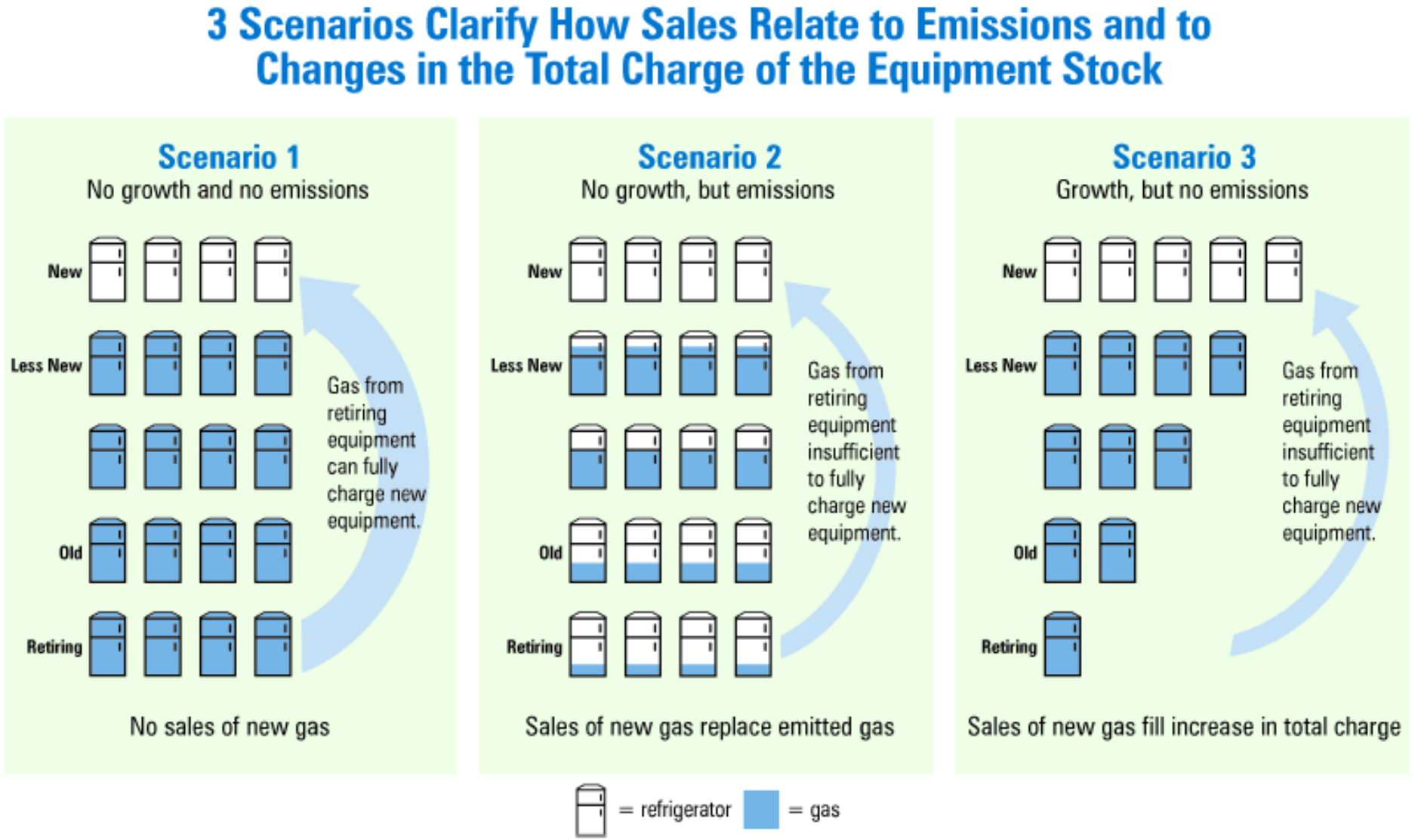
Overview

- Principles behind mass-balance approach for tracking emissions
- Application of mass-balance approach to reporting under subpart DD of the GHGRP

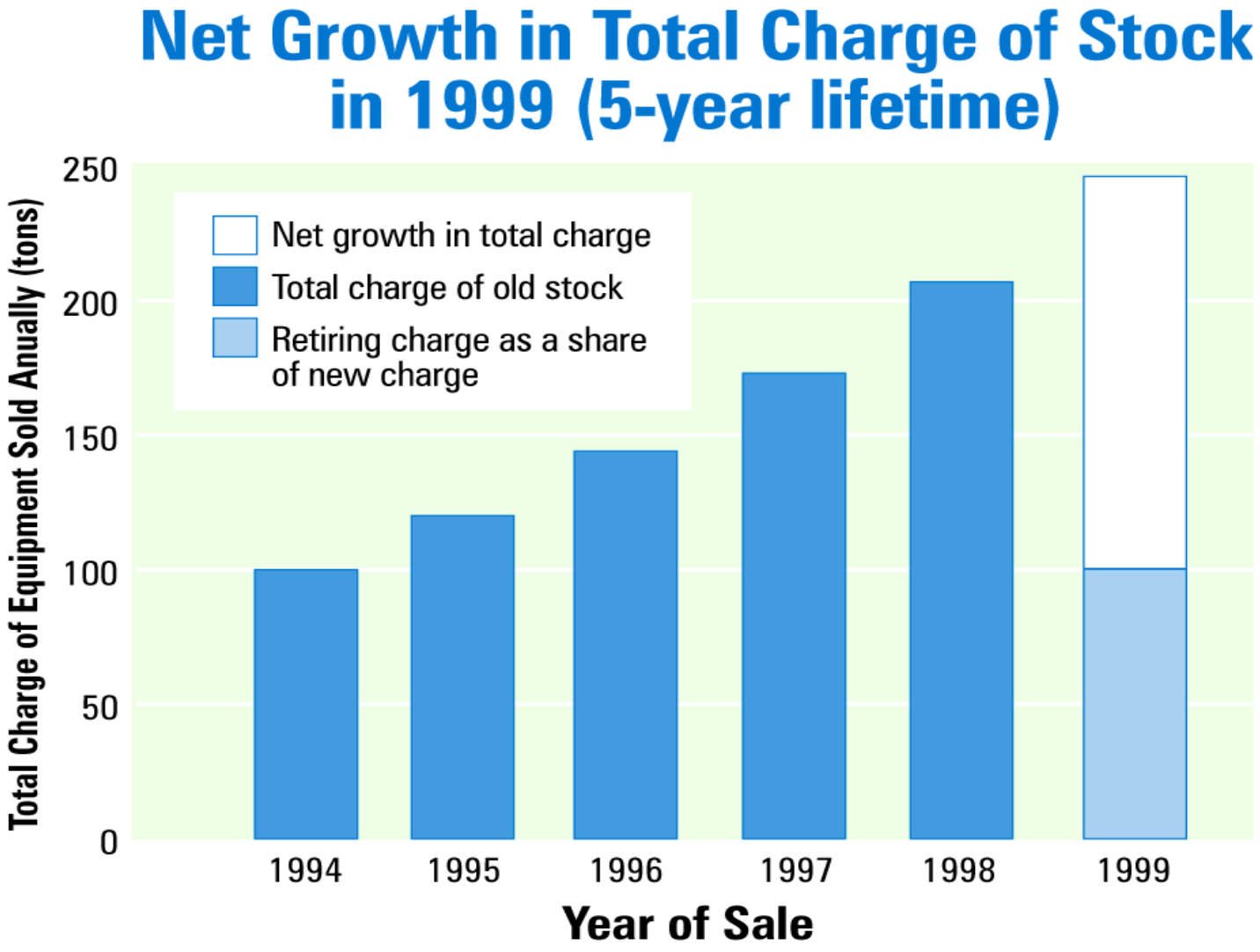
Principles Behind the Mass-Balance Approach



Principles Behind the Mass-Balance Approach (cont.)



Principles Behind the Mass-Balance Approach (cont.)



Applying the Mass-Balance Approach: Electrical Transmission & Distribution Equipment Use (Subpart DD)

Subpart DD – Eq. DD-1

User Emissions = (Decrease in Storage Inventory) + (Acquisitions) – (Disbursements)

– (Net increase in Total Nameplate Capacity of Equipment Operated)

Applying the Mass-Balance Approach: Electrical Transmission & Distribution Equipment Use (Subpart DD)

Subpart DD – Eq. DD-1

Table 2b (- "Stockpiling") *Table 2c ("New gas")* *Table 2d ("Destroyed gas")*

User Emissions = (Decrease in Storage Inventory) + (Acquisitions) – (Disbursements)

– (Net increase in Total Nameplate Capacity of Equipment Operated)

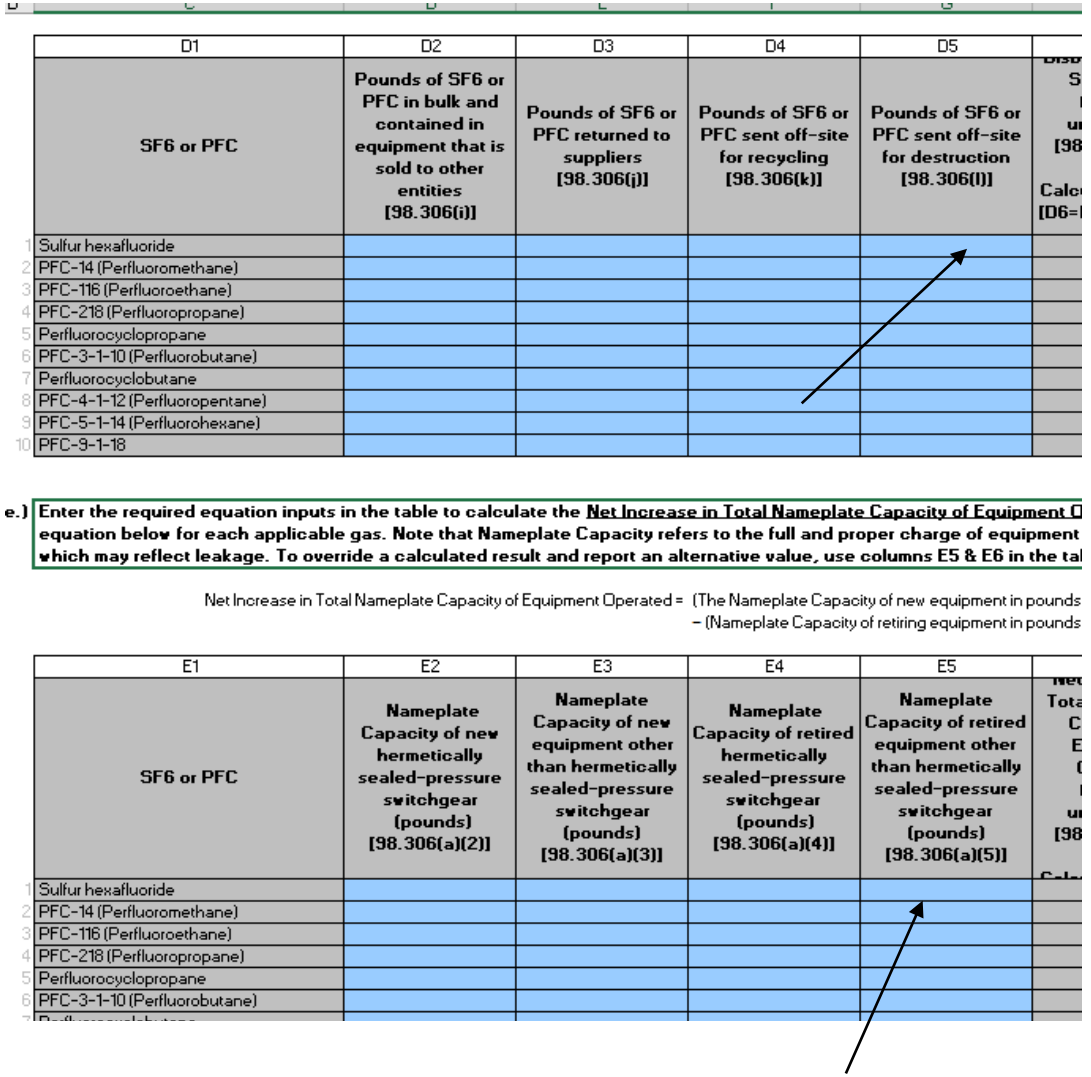
Table 2e ("Increase in equipment stocks" = New Equipment Nameplate Capacity – Retiring Equipment NC)

- "Inventory" refers to gas inside containers or non-energized equipment.
- Gas or nameplate associated with hermetically sealed-pressure equipment *must be included* in all the inputs to the mass-balance formula.
- Year-to-year consistency is important
  - Beginning-of-year (BOY) inventory must equal end-of-year inventory from the prior year.
  - BOY total nameplate capacity (NC) must equal BOY NC from prior year + net increase in NC (other than hermetic) in prior year. (Total NC not used in DD-1 but is used to calculate emission rate.)

Mass Balance in the GHGRP Reporting Form

Example 1: Equipment is removed from service and the gas is recovered and sent off-site for destruction.

- Include the disbursement of gas in Table 2d and the retirement of the equipment in Table 2e.



	D1	D2	D3	D4	D5	
	SF6 or PFC	Pounds of SF6 or PFC in bulk and contained in equipment that is sold to other entities [98.306(i)]	Pounds of SF6 or PFC returned to suppliers [98.306(j)]	Pounds of SF6 or PFC sent off-site for recycling [98.306(k)]	Pounds of SF6 or PFC sent off-site for destruction [98.306(l)]	
1	Sulfur hexafluoride					
2	PFC-14 (Perfluoromethane)					
3	PFC-116 (Perfluoroethane)					
4	PFC-218 (Perfluoropropane)					
5	Perfluorocyclopropane					
6	PFC-3-1-10 (Perfluorobutane)					
7	Perfluorocyclobutane					
8	PFC-4-1-12 (Perfluoropentane)					
9	PFC-5-1-14 (Perfluorohexane)					
10	PFC-9-1-18					

e.) Enter the required equation inputs in the table to calculate the Net Increase in Total Nameplate Capacity of Equipment O
equation below for each applicable gas. Note that Nameplate Capacity refers to the full and proper charge of equipment
which may reflect leakage. To override a calculated result and report an alternative value, use columns E5 & E6 in the tal

Net Increase in Total Nameplate Capacity of Equipment Operated = (The Nameplate Capacity of new equipment in pounds
– (Nameplate Capacity of retiring equipment in pounds

	E1	E2	E3	E4	E5	
	SF6 or PFC	Nameplate Capacity of new hermetically sealed-pressure switchgear (pounds) [98.306(a)(2)]	Nameplate Capacity of new equipment other than hermetically sealed-pressure switchgear (pounds) [98.306(a)(3)]	Nameplate Capacity of retired hermetically sealed-pressure switchgear (pounds) [98.306(a)(4)]	Nameplate Capacity of retired equipment other than hermetically sealed-pressure switchgear (pounds) [98.306(a)(5)]	
1	Sulfur hexafluoride					
2	PFC-14 (Perfluoromethane)					
3	PFC-116 (Perfluoroethane)					
4	PFC-218 (Perfluoropropane)					
5	Perfluorocyclopropane					
6	PFC-3-1-10 (Perfluorobutane)					

Mass Balance in the GHGRP Reporting Form

Example 2: Equipment is de-energized and removed from service but is not permanently retired. The de-energized equipment remains out of service at the end of the year.

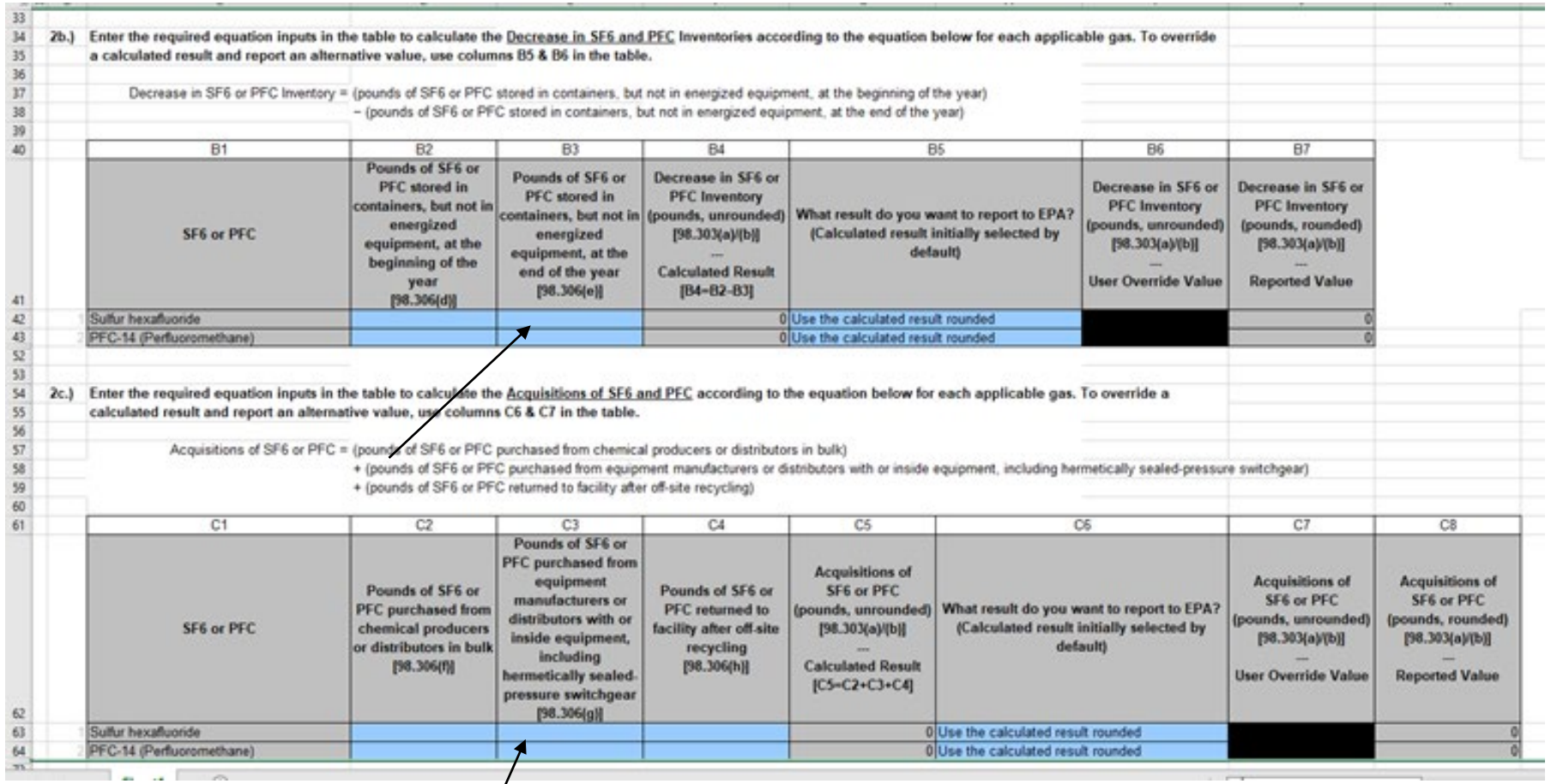
- Treat the gas as added to storage (Table 2b) and treat the equipment as retired (Table 2e).
- When equipment and gas are reinstalled, treat the gas as removed from storage and treat the equipment as new.

B1	B2	B3	B4	B5
SF6 or PFC	Pounds of SF6 or PFC stored in containers, but not in energized equipment, at the beginning of the year [98.306(d)]	Pounds of SF6 or PFC stored in containers, but not in energized equipment, at the end of the year [98.306(e)]	Decrease in SF6 or PFC Inventory (pounds, unrounded) [98.303(a)/(b)] --- Calculated Result [B4=B2-B3]	What result do you want to report to EPA? (Calculated result initially selected by default)
Sulfur hexafluoride	40	50	-10	Use the calculated result rounded

E1	E2	E3	E4	E5	E6
SF6 or PFC	Nameplate Capacity of new hermetically sealed-pressure switchgear (pounds) [98.306(a)(2)]	Nameplate Capacity of new equipment other than hermetically sealed-pressure switchgear (pounds) [98.306(a)(3)]	Nameplate Capacity of retired hermetically sealed-pressure switchgear (pounds) [98.306(a)(4)]	Nameplate Capacity of retired equipment other than hermetically sealed-pressure switchgear (pounds) [98.306(a)(5)]	Net Increase in Total Nameplate Capacity of Equipment Operated (pounds, unrounded) [98.303(a)/(b)] --- Calculated Result [E6=(E2+E3)-(E4+E5)]
Sulfur hexafluoride				10	-10

Mass Balance in the GHGRP Reporting Form

- Example 3: Gas is acquired in equipment, but equipment is not installed by end of year.



2b.) Enter the required equation inputs in the table to calculate the Decrease in SF6 and PFC Inventories according to the equation below for each applicable gas. To override a calculated result and report an alternative value, use columns B5 & B6 in the table.

Decrease in SF6 or PFC Inventory = (pounds of SF6 or PFC stored in containers, but not in energized equipment, at the beginning of the year)
− (pounds of SF6 or PFC stored in containers, but not in energized equipment, at the end of the year)

B1	B2	B3	B4	B5	B6	B7
SF6 or PFC	Pounds of SF6 or PFC stored in containers, but not in energized equipment, at the beginning of the year [98.306(d)]	Pounds of SF6 or PFC stored in containers, but not in energized equipment, at the end of the year [98.306(e)]	Decrease in SF6 or PFC Inventory (pounds, unrounded) [98.303(a)/(b)] — Calculated Result [B4=B2-B3]	What result do you want to report to EPA? (Calculated result initially selected by default)	Decrease in SF6 or PFC Inventory (pounds, unrounded) [98.303(a)/(b)] — User Override Value	Decrease in SF6 or PFC Inventory (pounds, rounded) [98.303(a)/(b)] — Reported Value
Sulfur hexafluoride			0	Use the calculated result rounded		0
PFC-14 (Perfluoromethane)			0	Use the calculated result rounded		0

2c.) Enter the required equation inputs in the table to calculate the Acquisitions of SF6 and PFC according to the equation below for each applicable gas. To override a calculated result and report an alternative value, use columns C6 & C7 in the table.

Acquisitions of SF6 or PFC = (pounds of SF6 or PFC purchased from chemical producers or distributors in bulk)
+ (pounds of SF6 or PFC purchased from equipment manufacturers or distributors with or inside equipment, including hermetically sealed-pressure switchgear)
+ (pounds of SF6 or PFC returned to facility after off-site recycling)

C1	C2	C3	C4	C5	C6	C7	C8
SF6 or PFC	Pounds of SF6 or PFC purchased from chemical producers or distributors in bulk [98.306(f)]	Pounds of SF6 or PFC purchased from equipment manufacturers or distributors with or inside equipment, including hermetically sealed-pressure switchgear [98.306(g)]	Pounds of SF6 or PFC returned to facility after off-site recycling [98.306(h)]	Acquisitions of SF6 or PFC (pounds, unrounded) [98.303(a)/(b)] — Calculated Result [C5=C2+C3+C4]	What result do you want to report to EPA? (Calculated result initially selected by default)	Acquisitions of SF6 or PFC (pounds, unrounded) [98.303(a)/(b)] — User Override Value	Acquisitions of SF6 or PFC (pounds, rounded) [98.303(a)/(b)] — Reported Value
Sulfur hexafluoride				0	Use the calculated result rounded		0
PFC-14 (Perfluoromethane)				0	Use the calculated result rounded		0

- Treat the gas as purchased (Table 2c) and added to storage (Table 2b). Do <u>not</u> add equipment to nameplate capacity.
- When equipment and gas are installed, treat the gas as removed from storage and treat the equipment as new.

Mass Balance in the GHGRP Reporting Form

Example 4: An electric power system purchases all or part of another electric power system, including energized electrical equipment, the SF6 inside it, and the SF6 in storage.

- Treat the equipment in the purchased system as new equipment, treat the gas inside that equipment as gas purchased with or inside of equipment, and treat the gas in the inventory of the purchased system as gas acquired in bulk.

C1	C2	C3	C4	C5
SF6 or PFC	Pounds of SF6 or PFC purchased from chemical producers or distributors in bulk [98.306(f)]	Pounds of SF6 or PFC purchased from equipment manufacturers or distributors with or inside equipment, including hermetically sealed-pressure switchgear [98.306(g)]	Pounds of SF6 or PFC returned to facility after off-site recycling [98.306(h)]	Acquisitions of SF6 or PFC (pounds, unrounded) [98.303(a)/(b)] --- Calculated Result [C5=C2+C3+C4]
Sulfur hexafluoride	200	1500	0	1700

E1	E2	E3	E4	E5	E6
SF6 or PFC	Nameplate Capacity of new hermetically sealed-pressure switchgear (pounds) [98.306(a)(2)]	Nameplate Capacity of new equipment other than hermetically sealed-pressure switchgear (pounds) [98.306(a)(3)]	Nameplate Capacity of retired hermetically sealed-pressure switchgear (pounds) [98.306(a)(4)]	Nameplate Capacity of retired equipment other than hermetically sealed-pressure switchgear (pounds) [98.306(a)(5)]	Net Increase in Total Nameplate Capacity of Equipment Operated (pounds, unrounded) [98.303(a)/(b)] --- Calculated Result [E6=(E2+E3)-(E4+E5)]
Sulfur hexafluoride		1500		0	1500

B1	B2	B3	B4
SF6 or PFC	Pounds of SF6 or PFC stored in containers, but not in energized equipment, at the beginning of the year [98.306(d)]	Pounds of SF6 or PFC stored in containers, but not in energized equipment, at the end of the year [98.306(e)]	Decrease in SF6 or PFC Inventory (pounds, unrounded) [98.303(a)/(b)] --- Calculated Result [B4=B2-B3]
Sulfur hexafluoride	100	300	-200

To Get the Right Result from the Reporting Form

- Account for all flows of gas and equipment.
  - For the gas, these flows include acquisitions (Table 2c), disbursements (Table 2d) and the decrease in the storage inventory (Table 2b).
  - For the equipment, these flows include the new and retiring equipment (Table 2e).
- If you make a change that affects the quantity of gas in storage or the nameplate capacity of equipment in service (e.g., temporarily de-installing equipment and placing it in storage), you must account for that change to ensure that you're correctly estimating emissions and emission rates.
- You must also ensure that both the equipment and the gas inside it are treated consistently, so that any calculated increases or decreases to the nameplate capacity of the equipment in operation are appropriately balanced by acquisitions, disbursements, or changes to the stored inventory of gas.
- Ensure totals for inventory and nameplate capacity are consistent from year to year.

Calculating Emissions under GHGRP: Electrical Transmission & Distribution Equipment Manufacturers (Subpart SS)

- **Subpart SS – Eq. SS-1**

User Emissions = (Decrease in Storage Inventory) + (Acquisitions) – (Disbursements)

- **Subpart SS – Eq. SS-6**

Emissions from Equipment Installation = (Total Mass used to Fill Equipment) + (Total Mass used to charge Equipment Prior to Leaving the Manufacturer Facility) – (Total Nameplate Capacity Installed at Electric T&D Facility)

  - Emissions that occur during installation while filling the equipment off-site from the electrical equipment manufacturing facility must be calculated and reported by the electrical equipment manufacturer under Subpart SS *until the title of the equipment has transferred to the electric power T&D entity*.
  - Once the title has transferred to the equipment user, the subpart DD facility is responsible for reporting emissions even if third-party conducts installation.