

Draft Amendments to the Regulation for Reducing Sulfur Hexafluoride (SF₆) Emissions from Gas Insulated Switchgear



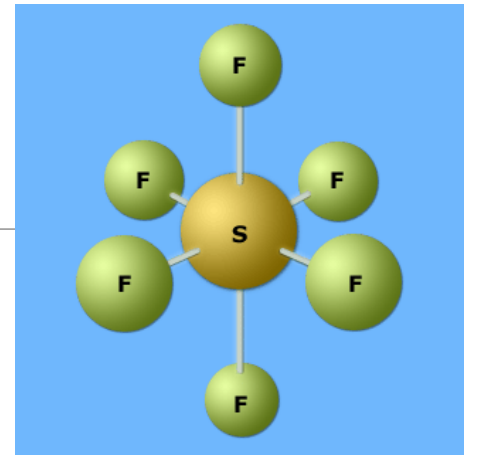
FEBRUARY 25, 2019

Workshop Materials and Comments

- This presentation and other materials are posted on our webpage: <https://ww2.arb.ca.gov/our-work/programs/elect-tandd/meetings-workshops>
- Presentation webcast: <https://video.calepa.ca.gov/>
- During this workshop, e-mail questions to: coastalrm@calepa.ca.gov
- Following the workshop, please submit written comments by 5:00 p.m. Pacific time on Monday, March 11, 2019 via our website: <https://ww2.arb.ca.gov/our-work/programs/elect-tandd/meetings-workshops>

SF₆ and Assembly Bill 32

- SF₆ is the most potent greenhouse gas (GHG)
 - Global warming potential (GWP) of 22,800 over 100 years (IPCC AR4)
 - Atmospheric lifetime of 3,200 years
- Electrical transmission and distribution equipment is the primary source of SF₆ emissions in California
- Assembly Bill 32 (2006) requires that the State reduce GHG emissions to the 1990 level by 2020
 - The Regulation for Reducing SF₆ Emissions from Gas Insulated Switchgear (SF₆ GIS Regulation) was adopted as an early action measure due to the high GWP of SF₆



Current SF₆ GIS Regulation

- Adopted by the Board in 2010 and went into effect in 2011
- Applies to owners of SF₆ GIS
- Sets an annual emission rate limit for SF₆ as a percentage of an owner's cumulative SF₆ nameplate capacity
 - Allowable emission rate started at 10 percent in 2011, decreased 1 percent per year until 2020, after which point it remains constant at 1 percent

Recent Climate Policy and Potential Amendments to the SF₆ GIS Regulation

- In 2016, the State's GHG emissions dropped below the 2020 target four years earlier than mandated
- Senate Bill 32 (2016) requires the State to reduce GHG emissions to 40 percent below the 1990 level by 2030
- Board Resolution 17-46 (2017) directs CARB staff to evaluate and explore opportunities to achieve additional cuts in GHG emissions from all sources
- CARB is evaluating regulatory amendments to the SF₆ GIS Regulation to:
 - Further reduce GHG emissions
 - Include non-SF6 GHG emissions
 - Streamline regulatory requirements

Nov 2017: Public workshop and release of draft revisions

May 2018: Public working group meeting

Feb 2019: Public workshop and release of discussion draft

Potential Revisions

- Add technical infeasibility exemption
- Phase out use of SF₆ in gas-insulated equipment (GIE)
- Change from an emission *rate* limit (%) to an *emissions* limit in metric tons of carbon dioxide equivalent (MTCO₂e)
- Include non-SF₆ GHGs
- Add a 5,500 MTCO₂e threshold for complying with the emissions limit
- Add process for adjusting nameplate capacity of GIE
- Revisions to reporting and recordkeeping requirements
- Other revisions

Technical Infeasibility Exemption

- Prior phase-out discussions demonstrated the need for a technical infeasibility exemption
 - Non-SF₆ GIE of certain types or characteristics may not be available by phase-out date
 - Available non-SF₆ GIE may not fit the location or technical requirements
- Staff proposes to include an exemption in the Regulation that would allow for acquisition of SF₆ GIE under the following conditions:
 - Non-SF₆ GIE meeting the specifications for the particular project are unavailable
 - Available non-SF₆ GIE cannot meet size requirements
 - Available non-SF₆ GIE is incompatible with existing equipment, wiring, or connectors
 - Available non-SF₆ GIE are not suitable based on safety or reliability requirements

Technical Infeasibility Exemption Application Process

- Application must include:
 - Description of the project and the amount and type of SF₆ GIE needed
 - Justification for the exemption
 - Summary of bid solicitations and responses from vendors
- CARB will notify submitter of approval/denial of application *or* request more information
- Exemption is approved if CARB does not contact submitter within 60 days of CARB's acknowledgment of receipt of the application

Phase-Out of SF₆ GIE

- To reduce GHG emissions, staff is proposing to phase out ability to acquire new SF₆ GIE
- Phase-out schedule based on expected availability of key GIS and dead tank circuit breakers, with at least three years for testing
 - Schedule is based on CARB staff communication with 11 manufacturers
- Staff proposes a phase-out schedule based on the voltage class of equipment
- After phase-out, new SF₆ GIE in that voltage class may only be acquired with an approved technical infeasibility exemption

Voltage (kV):	≤ 145	145 < kV ≤ 245	> 245
Potential Phase-Out Date:	1/1/2025	1/1/2029	1/1/2031

Annual GHG Emissions Limit and Threshold

- Propose change from an emission *rate* limit (%) to an *emissions* limit (MTCO₂e)
 - Applies beginning in 2020 data year, based on average system nameplate capacity for data year 2019, converted to CO₂e
 - Incentivizes transition to low-GWP or zero-GHG technologies
- Propose new threshold such that emissions limit is only applicable to GIE owners whose average CO₂e capacity is $\geq 5,500$ MTCO₂e
 - Emissions limit will apply to approximately 99% of capacity
 - More than half of all current GIE owners will not be subject to emissions limit

Annual Emissions Limit Calculation

$$\text{Emissions limit} = \frac{AEF_i}{100} * \text{Average } CO_2e \text{ Capacity}$$

- AEF_i = annual emission factor for each year (i)
- AEF_i decreases over time as SF₆ GIE is replaced with non-SF₆ GIE
- *Average CO₂e capacity* calculated using average system nameplate capacity for 2019 or the first data year that average CO₂e capacity is ≥5,500 MTCO₂e

Annual Emission Factor Calculation

$$\text{Emissions limit} = \frac{AEF_i}{100} * \text{Average CO}_2\text{e Capacity}$$

- Value of AEF_i for each year based on the following assumptions:
 - 20-year lifetime for switches; 40-year lifetime for all other GIE
 - Emissions decline at same rate as SF₆ capacity
- Methodology:
 - Used phase-out schedule and reported equipment ages to estimate State-wide SF₆ capacity from 2021 to 2050
 - AEF_i values correspond with SF₆ capacity

Year	AEF_i
2020-2034	1.0
2035-2039	0.95
2040-2042	0.90
2043-2045	0.80
2046-2048	0.70
2049+	0.60

Nameplate Capacity Adjustments (1 of 2)

- GIE owners requested that CARB add a nameplate capacity adjustment process because GIE's SF₆ capacity provided on nameplate may be inaccurate
- Considerations in developing a process include
 - Methodology required to revise nameplate capacity
 - Risk of additional SF₆ emissions
 - Cost and duration of process
 - Setting objective criteria for adjusting nameplate capacity for “priority” GIE

Nameplate Capacity Adjustments (2 of 2)

- CARB requests feedback on the following:
 - Which GIE owners must determine revised nameplate capacity values?
 - Which GIE must go through the process?
 - How will GIE owners ensure the process results in minimal additional SF₆ emissions?
 - When should the measurement be taken and all adjustments be completed?
 - Should CARB require that a consistent method be used for calculating revised nameplate capacity? If not, how can CARB be assured of consistent results?

Changes to Reporting and Recordkeeping

Line Item	Current Regulation	Potential Regulation
Report annual emission rate/limit	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Report container size and location	<input checked="" type="checkbox"/>	
Report inputs to calculation of annual emissions		<input checked="" type="checkbox"/>
Report type and GWP of insulating gas		<input checked="" type="checkbox"/>
Notify CARB of facility and GIE status changes		<input checked="" type="checkbox"/>
Substantive errors must be resolved within 45 days		<input checked="" type="checkbox"/>
Records must be retained for:	3 years	5 years

Other Revisions

- New requirements for manufacturers
 - Phase-out on sales of SF₆ equipment
 - Nameplate capacity of new equipment will be required to be accurate beginning on Jan. 1, 2021
- Clarify container weighing and reporting requirements
- Revising name of Regulation

Economic Analysis Assumptions for SF₆ GIE Phase-Out

- Replacement schedule based on 2017 inventory as reported to CARB
- 40-year lifetime for circuit breakers and gas-insulated switchgear; 20-year lifetime for switches
- Assumed a 3% annual growth rate based on reported data
- Analysis based on cost differences (capital purchase, operation and maintenance, training and reporting) between SF₆ and non-SF₆ GIE

Non-SF₆ GIE Purchase Cost Assumptions

- Limited data on upfront purchase cost difference between non-SF₆ and SF₆ equipment
- Cost difference varies by voltage class, but does not vary between non-SF₆ technology types
- Additional input welcomed

Voltage Class (kV)	Cost Difference (\$/equipment)
kV ≤ 15	\$3,000
15 < kV ≤ 36	\$3,000
36 < kV ≤ 72.5	\$6,000
72.5 < kV ≤ 145	\$10,000
145 < kV ≤ 245	\$10,000
kV > 245	\$50,000

Non-SF₆ GIE Maintenance & Reporting Cost Assumptions

- Maintenance includes but not limited to gas purchase, inspection, and repair
- Cost difference varies by non-SF₆ technology type:
 - Similar level of maintenance for alternative gas technologies and SF₆, hence zero cost difference
 - “Maintenance-free” technologies result in cost benefit
- Anticipated technology market share based on initial assessment of technology development and constraints; CARB requests feedback on the expected market share, by voltage class, for each technology type
- Reporting cost difference varies by non-SF₆ technology type:
 - Similar reporting requirements for alternative gas technologies and SF₆, hence zero cost difference
 - Zero-GWP technologies exempt from reporting requirements, hence a cost benefit

Next Steps and Additional Information

- Please submit written comments by 5:00 p.m. Pacific time on Monday, March 11, 2019 via our website: <https://ww2.arb.ca.gov/our-work/programs/elect-tandd/meetings-workshops>
- Present regulatory amendments to the Board before the end of 2019
- Regulation effective in 2020
- For additional information on the SF₆ Regulation, visit <https://www.arb.ca.gov/cc/sf6elec/sf6elec.htm> or email energy@arb.ca.gov
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