

# Draft Amendments to the Regulation for Reducing Sulfur Hexafluoride (SF<sub>6</sub>) Emissions from Gas Insulated Switchgear

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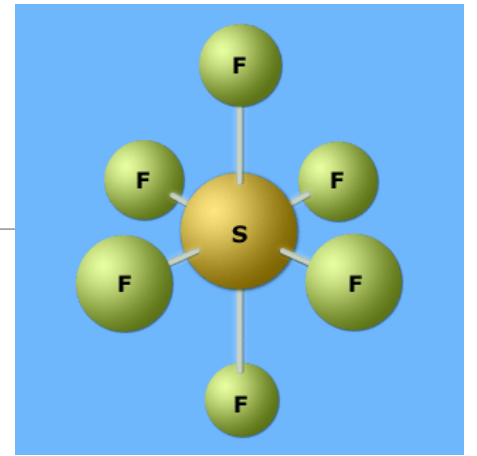
# Workshop Materials and Comments

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- 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](mailto: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>

# SF<sub>6</sub> and Assembly Bill 32

- SF<sub>6</sub> 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 SF<sub>6</sub> emissions in California
- Assembly Bill 32 (2006) requires that the State reduce GHG emissions to the 1990 level by 2020
  - The Regulation for Reducing SF<sub>6</sub> Emissions from Gas Insulated Switchgear (SF<sub>6</sub> GIS Regulation) was adopted as an early action measure due to the high GWP of SF<sub>6</sub>



# Current SF<sub>6</sub> GIS Regulation

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- Adopted by the Board in 2010 and went into effect in 2011
- Applies to owners of SF<sub>6</sub> GIS
- Sets an annual emission rate limit for SF<sub>6</sub> as a percentage of an owner's cumulative SF<sub>6</sub> 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 SF<sub>6</sub> GIS Regulation

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- 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 SF<sub>6</sub> 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

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- Add technical infeasibility exemption
- Phase out use of SF<sub>6</sub> in gas-insulated equipment (GIE)
- Change from an emission *rate* limit (%) to an *emissions* limit in metric tons of carbon dioxide equivalent (MTCO<sub>2</sub>e)
- Include non-SF<sub>6</sub> GHGs
- Add a 5,500 MTCO<sub>2</sub>e 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

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- Prior phase-out discussions demonstrated the need for a technical infeasibility exemption
  - Non-SF<sub>6</sub> GIE of certain types or characteristics may not be available by phase-out date
  - Available non-SF<sub>6</sub> GIE may not fit the location or technical requirements
- Staff proposes to include an exemption in the Regulation that would allow for acquisition of SF<sub>6</sub> GIE under the following conditions:
  - Non-SF<sub>6</sub> GIE meeting the specifications for the particular project are unavailable
  - Available non-SF<sub>6</sub> GIE cannot meet size requirements
  - Available non-SF<sub>6</sub> GIE is incompatible with existing equipment, wiring, or connectors
  - Available non-SF<sub>6</sub> GIE are not suitable based on safety or reliability requirements

# Technical Infeasibility Exemption Application Process

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- Application must include:
  - Description of the project and the amount and type of SF<sub>6</sub> 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 SF<sub>6</sub> GIE

- To reduce GHG emissions, staff is proposing to phase out ability to acquire new SF<sub>6</sub> 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 SF<sub>6</sub> 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

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- Propose change from an emission *rate* limit (%) to an *emissions* limit (MTCO<sub>2</sub>e)
  - Applies beginning in 2020 data year, based on average system nameplate capacity for data year 2019, converted to CO<sub>2</sub>e
  - Incentivizes transition to low-GWP or zero-GHG technologies
- Propose new threshold such that emissions limit is only applicable to GIE owners whose average CO<sub>2</sub>e capacity is  $\geq 5,500$  MTCO<sub>2</sub>e
  - 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

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

- $AEF_i$  = annual emission factor for each year ( $i$ )
- $AEF_i$  decreases over time as SF<sub>6</sub> GIE is replaced with non-SF<sub>6</sub> GIE
- *Average CO<sub>2</sub>e capacity* calculated using average system nameplate capacity for 2019 or the first data year that average CO<sub>2</sub>e capacity is ≥5,500 MTCO<sub>2</sub>e

# 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 SF<sub>6</sub> capacity
- Methodology:
  - Used phase-out schedule and reported equipment ages to estimate State-wide SF<sub>6</sub> capacity from 2021 to 2050
  - $AEF_i$  values correspond with SF<sub>6</sub> 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)

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- GIE owners requested that CARB add a nameplate capacity adjustment process because GIE's SF<sub>6</sub> capacity provided on nameplate may be inaccurate
- Considerations in developing a process include
  - Methodology required to revise nameplate capacity
  - Risk of additional SF<sub>6</sub> emissions
  - Cost and duration of process
  - Setting objective criteria for adjusting nameplate capacity for “priority” GIE

# Nameplate Capacity Adjustments (2 of 2)

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- 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 SF<sub>6</sub> 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

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- New requirements for manufacturers
  - Phase-out on sales of SF<sub>6</sub> 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 SF<sub>6</sub> GIE Phase-Out

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- 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 SF<sub>6</sub> and non-SF<sub>6</sub> GIE

# Non-SF<sub>6</sub> GIE Purchase Cost Assumptions

- Limited data on upfront purchase cost difference between non-SF<sub>6</sub> and SF<sub>6</sub> equipment
- Cost difference varies by voltage class, but does not vary between non-SF<sub>6</sub> 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-SF<sub>6</sub> GIE Maintenance & Reporting Cost Assumptions

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- Maintenance includes but not limited to gas purchase, inspection, and repair
- Cost difference varies by non-SF<sub>6</sub> technology type:
  - Similar level of maintenance for alternative gas technologies and SF<sub>6</sub>, 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-SF<sub>6</sub> technology type:
  - Similar reporting requirements for alternative gas technologies and SF<sub>6</sub>, hence zero cost difference
  - Zero-GWP technologies exempt from reporting requirements, hence a cost benefit

# Next Steps and Additional Information

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- 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 SF<sub>6</sub> Regulation, visit <https://www.arb.ca.gov/cc/sf6elec/sf6elec.htm> or email [energy@arb.ca.gov](mailto:energy@arb.ca.gov)
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