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 SF$_6$ GIS Regulation

- Adopted by the Board in 2010 and went into effect in 2011
- Applies to owners of SF$_6$ GIS
- Sets an annual emission rate limit for SF$_6$ as a percentage of an owner’s cumulative SF$_6$ 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$_6$ 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 SF$_6$ 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-SF$_6$ GIE of certain types or characteristics may not be available by phase-out date
  - Available non-SF$_6$ 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$_6$ GIE under the following conditions:
  - Non-SF$_6$ GIE meeting the specifications for the particular project are unavailable
  - Available non-SF$_6$ GIE cannot meet size requirements
  - Available non-SF$_6$ GIE is incompatible with existing equipment, wiring, or connectors
  - Available non-SF$_6$ 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 SF$_6$ GIE

- To reduce GHG emissions, staff is proposing to phase out ability to acquire new SF$_6$ 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$_6$ GIE in that voltage class may only be acquired with an approved technical infeasibility exemption.

<table>
<thead>
<tr>
<th>Voltage (kV):</th>
<th>≤ 145</th>
<th>145 &lt; kV ≤ 245</th>
<th>&gt; 245</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential Phase-Out Date:</td>
<td>1/1/2025</td>
<td>1/1/2029</td>
<td>1/1/2031</td>
</tr>
</tbody>
</table>
Propose change from an emission rate limit (%) to an emissions limit (MTCO$_2$e)

- Applies beginning in 2020 data year, based on average system nameplate capacity for data year 2019, converted to CO$_2$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$_2$e capacity is $\geq$5,500 MTCO$_2$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

\[ Emissions\ limit = \frac{AEF_i}{100} \times Average\ CO_2e\ Capacity \]

- \( AEF_i \) = annual emission factor for each year \((i)\)
- \( AEF_i \) decreases over time as \( SF_6 \) GIE is replaced with non-\( SF_6 \) GIE
- \( Average\ CO_2e\ capacity \) calculated using average system nameplate capacity for 2019 or the first data year that average \( CO_2e \) capacity is \( \geq 5,500 \) MTCO\(_2\)e
Annual Emission Factor Calculation

\[
Emissions \ limit = \frac{AEF_i}{100} \times \text{Average CO}_2\text{e Capacity}
\]

- 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\(_6\) capacity
- Methodology:
  - Used phase-out schedule and reported equipment ages to estimate State-wide SF\(_6\) capacity from 2021 to 2050
  - \( AEF_i \) values correspond with SF\(_6\) capacity

<table>
<thead>
<tr>
<th>Year</th>
<th>( AEF_i )</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020-2034</td>
<td>1.0</td>
</tr>
<tr>
<td>2035-2039</td>
<td>0.95</td>
</tr>
<tr>
<td>2040-2042</td>
<td>0.90</td>
</tr>
<tr>
<td>2043-2045</td>
<td>0.80</td>
</tr>
<tr>
<td>2046-2048</td>
<td>0.70</td>
</tr>
<tr>
<td>2049+</td>
<td>0.60</td>
</tr>
</tbody>
</table>
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 $\text{SF}_6$ 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

<table>
<thead>
<tr>
<th>Line Item</th>
<th>Current Regulation</th>
<th>Potential Regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Report annual emission rate/limit</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Report container size and location</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Report inputs to calculation of annual emissions</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Report type and GWP of insulating gas</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Notify CARB of facility and GIE status changes</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Substantive errors must be resolved within 45 days</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Records must be retained for:</td>
<td>3 years</td>
<td>5 years</td>
</tr>
</tbody>
</table>
Other Revisions

- New requirements for manufacturers
  - Phase-out on sales of SF$_6$ 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$_6$ 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 SF$_6$ and non-SF$_6$ GIE
Non-SF$_6$ GIE Purchase Cost Assumptions

- Limited data on upfront purchase cost difference between non-SF$_6$ and SF$_6$ equipment
- Cost difference varies by voltage class, but does not vary between non-SF$_6$ technology types
- Additional input welcomed

<table>
<thead>
<tr>
<th>Voltage Class (kV)</th>
<th>Cost Difference ($/equipment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>kV ≤ 15</td>
<td>$3,000</td>
</tr>
<tr>
<td>15 &lt; kV ≤ 36</td>
<td>$3,000</td>
</tr>
<tr>
<td>36 &lt; kV ≤ 72.5</td>
<td>$6,000</td>
</tr>
<tr>
<td>72.5 &lt; kV ≤ 145</td>
<td>$10,000</td>
</tr>
<tr>
<td>145 &lt; kV ≤ 245</td>
<td>$10,000</td>
</tr>
<tr>
<td>kV &gt; 245</td>
<td>$50,000</td>
</tr>
</tbody>
</table>
Non-SF\textsubscript{6} GIE Maintenance & Reporting Cost Assumptions

- Maintenance includes but not limited to gas purchase, inspection, and repair
- Cost difference varies by non-SF\textsubscript{6} technology type:
  - Similar level of maintenance for alternative gas technologies and SF\textsubscript{6}, 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\textsubscript{6} technology type:
  - Similar reporting requirements for alternative gas technologies and SF\textsubscript{6}, 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](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](https://www.arb.ca.gov/cc/sf6elec/sf6elec.htm) or email energy@arb.ca.gov
- Contact:
  - Carey Bylin
    - 916-445-1952
    - carey.bylin@arb.ca.gov
  - Brian Cook
    - 916-322-4299
    - brian.cook@arb.ca.gov