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
SF$_6$ and Assembly Bill 32

- SF$_6$ 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$_6$ 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$_6$ Emissions from Gas Insulated Switchgear (SF$_6$ GIS Regulation) was adopted as an early action measure due to the high GWP of SF$_6$
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 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 $\text{SF}_6$ 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>$\leq 145$</th>
<th>$145 &lt; kV \leq 245$</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>
Annual GHG Emissions Limit and Threshold

- 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 ≥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\(_{2e}\)
Annual Emission Factor Calculation

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

- **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
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

<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 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 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-$\text{SF}_6$ GIE Purchase Cost Assumptions

- Limited data on upfront purchase cost difference between non-$\text{SF}_6$ and $\text{SF}_6$ equipment
- Cost difference varies by voltage class, but does not vary between non-$\text{SF}_6$ 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<sub>6</sub> GIE Maintenance & Reporting Cost Assumptions

- 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

 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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