



NRG Energy, Inc.
4600 Carlsbad Boulevard
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September 22, 2020

By Email: carey.bylin@arb.ca.gov

Ms. Carey Bylin
Climate Change Program Evaluation Branch
California Air Resource Board
1001 I Street
Sacramento, California 95812

Re: NRG Energy, Inc.'s Comments on Proposed Amendments to the Regulation for Reducing Sulfur Hexafluoride Emissions From Gas Insulated Switchgear, dated July 21, 2020

Dear Ms. Bylin:

NRG Energy, Inc. (NRG) appreciates the opportunity to submit these comments in response to the potential changes to the California Air Resources Board (ARB) Regulation for Reducing Greenhouse Gas Emissions from Gas Insulated Equipment (SF6 Regulation) issued on July 21, 2020 in the ARB Staff initial statement of reasons titled, Proposed Amendments to the Regulation for Reducing Sulfur Hexafluoride Emissions From Gas Insulated Switchgear (Proposed Amendments). These comments are in addition to comments NRG made during ARB's workshops on the SF6 Regulation, comments made previously in numerous conversations and communications with ARB staff since 2015, and previously submitted written comments on March 11, 2019 (*regarding Discussion Draft – issued February 22, 2019*) and December 20, 2017 (*regarding "Strawman Proposal" – issued November 16, 2017*).

We have proposed SF6 Regulation amendments that (1) provide an appropriate de minimis threshold for reporting and enforcement – an example of such language is provided below; (2) acknowledge phantom emissions during retirement of sulfur hexafluoride (SF6) gas insulated equipment (GIE); (3) promote and encourage early and/or timely retirement

of GIE ; and (4) include maintenance provisions that will ensure safe and environmentally compliant operations of GIE .

Appropriate De Minimis Threshold

NRG disagrees with ARB's revised approach to address facilities with "small facility inventories" in the latest Proposed Amendments. ARB's approach to remove the <5,500 MTCO_{2e} emissions limit applicability (i.e., "de minimis") that was presented in the 2019 Discussion Draft, and replace it with a 2% Annual Emission Factor (AEF) for average CO_{2e} capacities <10,000 MTCO_{2e} (Table 5 of Proposed Amendments) does little to prevent facilities/owners with small capacity inventories from being subject to continued enforcement with substantial fines for small or even zero emission events attributed to phantom emissions; many of the potentially small emission events that could result in substantial fines may result from prudent, Original Equipment Manufacturer (OEM) recommended preventative maintenance inspections.

ARB had previously stated that the proposed de minimis threshold was established as the mid-point for all reporting entities, with half of the reporters having inventories >5,500 MTCO_{2e} and half of the reporters having inventories <5,500 MTCO_{2e}. Recently, in the latest SF₆ workshop, ARB further highlighted that facilities/owners with capacities <10,000 MTCO_{2e} account for <2% of the total statewide SF₆ capacity inventory. This information reinforces that ARB has not established a realistic de minimis threshold that fairly considers the number of small facility inventories and the corresponding inventories held by these facilities. We believe that the de minimis inventory threshold should be established at no less than 10,000 MTCO_{2e} – a point to which we elaborate further below.

If the actual potential of emissions from small facility inventories is <2% of the total statewide SF₆ capacity inventory, then why is ARB proposing a disproportionate and inequitable regulation for emissions from small facility inventories? We understand that ARB believes that facilities with small inventories (<10,000 MTCO_{2e}) can comply with the proposed 2% AEF because these types of small inventory facilities largely complied with the 2% AEF in 2019. However, basing the proposed amendments for small facility inventories on a single high-performing year is shortsighted and inappropriate when you consider the historical maintenance requirements of GIE. As an example, a small facility inventory in California could have six (6) identical 15-lb breakers that have had historical maintenance events, which typically result in 2-lbs of SF₆ gas needing to be added due to a maintenance event. Compliance under the new proposed amendment would only allow a 1.8-lb emission limit for the year, which means that this facility

would have an AEF exceedance and be in violation of the proposed amendments for this small maintenance event. This example illustrates that the proposed 2% AEF is likely to continue to disproportionately penalize small emitters, while entities with larger inventories will likely continue to have “compliant” actual emissions based on the percentage of losses as compared to the significantly greater inventories held by these entities. The 2% AEF does not support or promote compliance for small facility inventories, as it provides little relief for unavoidable emissions that could occur during regularly scheduled preventative maintenance, unscheduled repair maintenance activities, and voluntary early retirement of GIE equipment with phantom emissions.

Acknowledgement of Phantom Emissions

NRG also continues to reinforce the need for ARB to recognize and treat phantom emissions of SF6 distinctly from actual emissions of SF6 that should not be penalized. The issue with respect to phantom emissions came to light during NRG’s recent retirement of older (1970s and older) SF6 GIE. NRG recognizes as well as many within the industry that we could not have foreseen or appreciated the systemic discrepancies experienced when utilizing GIE nameplate capacities as a means for determining emissions when the current SF6 Regulation was drafted, commented upon, and approved. However, the reality is that the majority of older SF6 GIE does not contain the volume/weight of SF6 as indicated by their respective OEM nameplate capacity. The issues with nameplate discrepancies have also been continually highlighted by industry and agency representatives as demonstrated in EPA’s SF6 Conference in San Francisco January 24-25, 2017. Mr. Dave Mehl of the ARB briefly touched on the issue of discrepancies of Nameplate Capacity vs. Actual Capacity (Attachment A - see slide 8 of attached Mehl Presentation), and John Stewart of National Electrical Manufacturers Association (NEMA) addressed the prevalence of discrepancies of nameplate capacities demonstrated through actual maintenance events (Attachment B - see slide 11 of attached Stewart Presentation). NRG appreciates that ARB staff believes that the current SF6 regulation addresses this issue of phantom emissions by allowing the OEM to rename GIE nameplate capacities through an engineering evaluation. However, ARB staff should be aware that this methodology does not apply in every instance, and this nameplate capacity engineering evaluation should not be considered as the mechanism by which phantom emissions are addressed.

For example, NRG presents the following two real-world case studies which demonstrate the inaccuracies associated with older GIE nameplate

capacities, and the issue that phantom emissions create for both ARB and the GIE owner. The first example relates to the retirement of four (4) identical 1965 Westinghouse circuit breakers with SF6 OEM nameplate capacity(ies) of 760-lbs each. NRG retired these four circuit breakers over the course of three years in an attempt to retire them in a manner that would prevent an exceedance of the AER. All four circuit breakers were operating within the OEM standard pressures and temperatures at the time of retirement indicating that there had not been measurable losses. Additionally, these circuit breakers have a 10% volume loss alarm by design, and none of these circuit breakers were in alarm at retirement or had been in alarm for several years prior to their retirement. At retirement, 663-lb, 656-lbs, 640-lbs, and 636-lbs of SF6, respectively, were removed from the breaker, which equates to a 4% difference between the four circuit breakers. To add to our point about the difficult parameters under which to comply with the regulation, the SF6 recovery from these four breakers demonstrated accuracy and precision of the actual amounts recovered from fully and appropriately operating breakers, yet the differences among the SF6 recoveries from these breakers was still more than 2% - more than the allowed losses by the proposed amendments. Due to the significant difference in the original nameplates vs. the actual recoveries of SF6 for these four circuit breakers, NRG contracted with the OEM to perform an engineering evaluation to assess the nameplate capacity of this model circuit breaker at a cost of \$15,000. The result of the engineering evaluation was a renaming of the nameplate capacity to 721-lbs (*Attachment C - ABB Report of Findings on the SF6 Gas Amounts in Westinghouse Type 2300SF Circuit Breaker*). This engineering analysis did not substantially change the original nameplate capacity and further illustrated that these efforts will not in every instance remove or address the issue of phantom emissions. The differences between either the original nameplate capacity (760-lbs) or revised nameplate capacity (721-lbs) and the actual volume removed from each of these four identical, properly operating circuit breakers provide strong evidence that there were substantially less actual capacity in these identical breakers, indicating that it is more probable that there were not reportable emissions above the limit at the time of the retirement of these breakers. Regardless the current SF6 regulation resulted in the described multi-year retirement effort to avoid exceedances simply due to phantom emissions.

The second example relates to the retirement of another NRG subsidiary-owned 1975 ITE dual pressure circuit breaker with a nameplate capacity of 935-lbs. The ITE circuit breaker was fully operational at the time of retirement. 837-lbs of SF6 were removed from the circuit breaker upon its retirement. While acknowledging that there is not as much detail regarding this ITE circuit breaker as only one of these circuit breakers was

retired, NRG nonetheless asserts the same nameplate capacity discrepancies observed and demonstrated with the four identical Westinghouse circuit breakers are consistent with the retirement of this circuit breaker as well. In addition, the large capacity of the ITE circuit breaker example can mathematically drive the facility inventory and emissions rate for small facility inventories, making a non-compliance event unavoidable when nameplate capacity discrepancies exist.

Promote and Encourage Retirement of SF6 GIE

ARB's Proposed Amendments' failure to address the retirement of SF6 GIE and potential phantom emissions will create substantial non-compliance and enforcement issues across both large and small capacity inventory owners/facilities in the future as the phase-out of SF6 GIE occurs. NRG strongly believes that language must be included which promotes, encourages and incentivizes the early and/or timely retirement of SF6 GIE to achieve the complete phase-out of SF6 GIE, and specifically to provide a transparent process to retire SF6 GIE with phantom emissions.

To that end, NRG recommends that ARB provide a voluntary variance or pre-approved retirement verification process. The Proposed Amendments already outline and provide a template for such a construct with the Emergency Event Exemption process in Section 35357.1, and a similar voluntary retirement exemption process could be included with additional operational and maintenance considerations that would be part of the evidence necessary to receive an approved verification for a permanent retirement exemption from ARB. The process could be similar to the Third Party Verification process which is required for verifying annual GHG emissions under the Mandatory Reporting Rule. Authorizing a voluntary retirement variance framework would create a cost-effective mechanism when compared to enforcement penalties to facilitate the timely retirement of SF6 GIE, remove potential SF6 liability for SF6 GIE awaiting retirement or being delayed in an attempt to achieve the AEF, and lastly promote and encourage the phase-out of SF6 GIE which is a primary focus of this Proposed Amendments. This process would be in-line with ARB's goals to reduce potential losses from equipment employing SF6, if not the complete and permanent removal of the use of SF6.

NRG also continues to highlight the need for language which allows an entity to permanently retire a GIE device at any date within the year, and that the annual inventory not be required to be time-weighted averaged in such instances of retired GIE devices. The current regulation could potentially and inadvertently force a GIE device owner to delay the retirement of a GIE

Ms. Carey Bylin
September 22, 2020
Page 6

device, thus creating the potential for real emissions, because an early retirement requires the annual inventory to be recalculated based on a time-weighted average. The GIE owner/operator should be able to permanently retire a GIE device at any point within the year, and avoid potential non-compliance due to a calculated reduced emissions rate.

Inclusion of Maintenance Provisions

Lastly, the Proposed Amendments should encourage and promote the proper maintenance of SF6 GIE. The Proposed Amendments do not currently require, encourage, or allow for preventative maintenance. NRG recommends that ARB include language that exempts minor losses (i.e., 2% or less) associated with maintenance events, if, and only if, the SF6 GIE owner has demonstrated and can document that precautions and best-management-practices were implemented during the maintenance event.

Should you have any questions regarding the recommendations or comments, do not hesitate to contact me.

Very truly yours,

Sean P. Beatty

Sean P. Beatty
Regional General Counsel - West
NRG Energy, Inc.

Attachments

cc (w/attachments):

Brian Cook – Air Resources Board
George Piantka – NRG Energy, Inc.
Timothy Sisk – NRG Energy, Inc.

Ms. Carey Bylin
September 22, 2020
Page 7

**Attachment A
Mehl Presentation**



California Environmental Protection Agency

AIR RESOURCES BOARD

Update on California's Regulation for Reducing Sulfur Hexafluoride Emissions from Gas Insulated Switchgear

California Air Resources Board

January 25, 2017

Overview

- ◆ Regulation Update
- ◆ 2015 SF₆ Annual Reports
- ◆ SF6 Emissions from GIS
- ◆ Enforcement
- ◆ Inspections
- ◆ Where are we now?
- ◆ Contacts



REGULATION UPDATE



Affected Entities

- ◆ Investor-owned utilities
- ◆ Publically-owned utilities
- ◆ Co-generating industries
- ◆ Military
- ◆ Universities
- ◆ State government
- ◆ Private Sector

Key Elements of the Regulation

- ◆ Annual maximum emission rate
- ◆ Initial emission rate at 10% of nameplate capacity
- ◆ GIS owners must reduce their SF₆ emission rate by 1% per year over a ten year period from 2011 to 2020
- ◆ Beginning in 2020, maximum emission rate not to exceed 1%

Recordkeeping and Reporting Requirements

- ◆ Compliance through recordkeeping and reporting
- ◆ Annual reports are due June 1 each year and must include:
 - SF₆ emissions
 - SF₆ emission rate
- ◆ GIS owners must have available upon ARB request:
 - Current SF₆ inventories
 - GIS SF₆ nameplate capacity
- ◆ All records must be retained for three years

Emergency Event

- ◆ Section 95351(a)(3)

- **“Emergency Event”** means a situation arising from a sudden and unforeseen event including, but not limited to, an earthquake, flood, or fire.

- ◆ Section 95353

- Emergency Event Exemption

Nameplate Capacity

- ◆ Section 95351(a)(10)
 - **“Nameplate Capacity”** means the design capacity of SF6 specified by the manufacturer for optimal performance of a GIS device. Nameplate capacity may be found on the nameplate attached to the GIS device, or may be stated within the manufacturer’s official product specifications.
- ◆ Section 95356(d): *Annual SF6 Emissions*
- ◆ Section 95356(e): *Annual SF6 Emission Rate*
- ◆ Discrepancies in nameplate vs. actual capacity

2015 SF₆ ANNUAL REPORTS

- ◆ 231 facilities
- ◆ 40,635 lb SF₆ emitted
- ◆ 1.9 million lb nameplate capacity
- ◆ 2.1% average emission rate
- ◆ Approx. 49k GIS devices



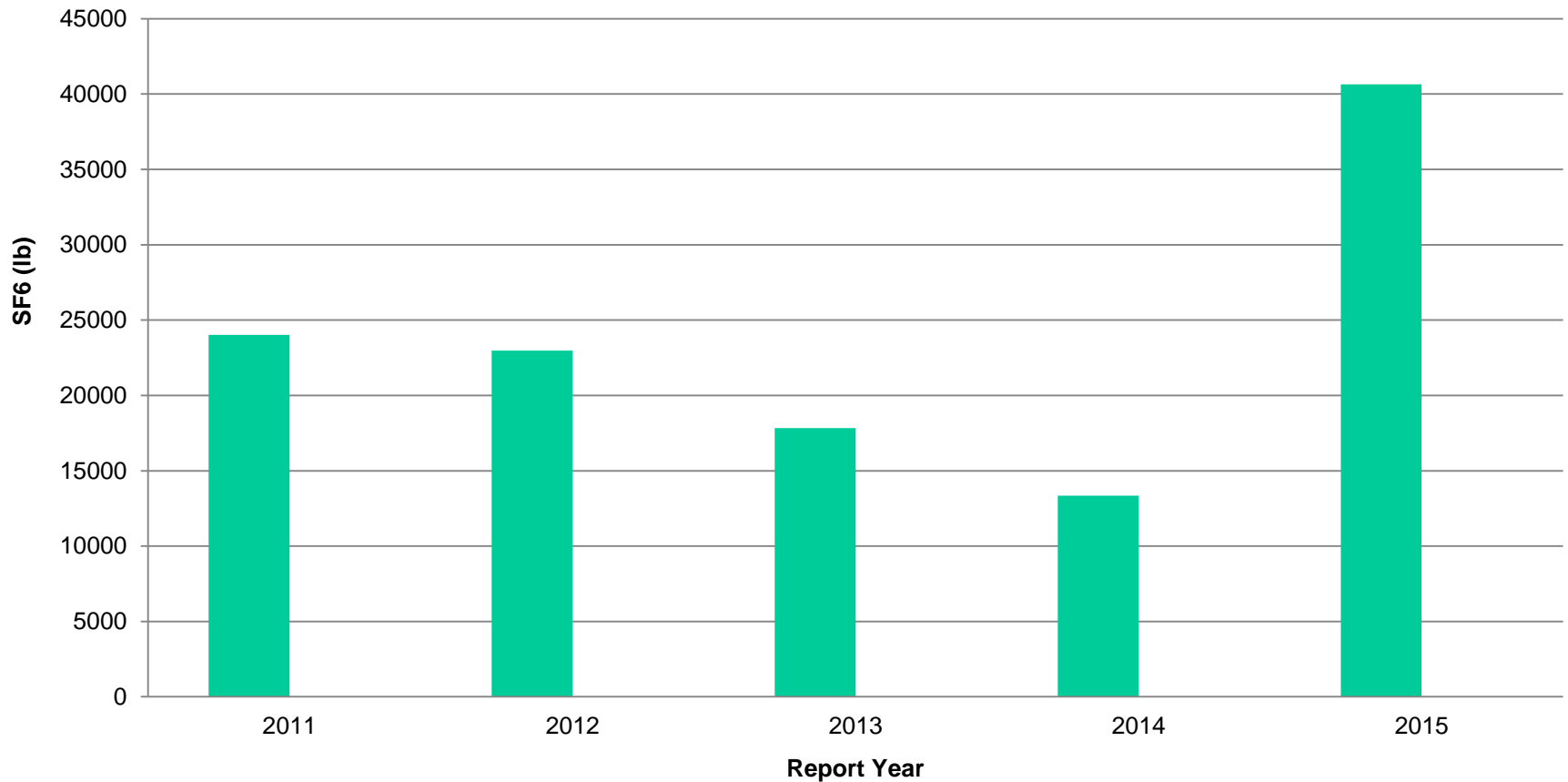
SF6 EMISSIONS FROM GIS



California's GIS SF6 Emissions Trends

Report Year	SF6 Emissions (lbs.)	SF6 Emission Rate (%)	SF6 MMTCO2e
2011	24,021	1.3	0.26
2012	22,982	1.2	0.25
2013	17,839	0.9	0.19
2014	13,340	0.6	0.15
2015	40,635	2.1	0.44

CA SF6 Emissions from GIS



ENFORCEMENT

- ◆ Enforcement action initiated or completed on 10 entities for 2011- 2014 reporting years
- ◆ Enforcement action initiated or under consideration on four (4) entities from the 2015 reporting year



INSPECTIONS

- ◆ Fall 2013: Started conducting inspections
- ◆ Approx. 15 inspections to date



WHERE ARE WE NOW?



Update

- ◆ 2016 Annual Report due to ARB by June 1
- ◆ Continue to review reports
- ◆ Inspections will be ongoing
- ◆ FAQs last updated in August 2014
- ◆ Will continue working with regulated parties

CONTACTS

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Ms. Carey Bylin
September 22, 2020
Page 8

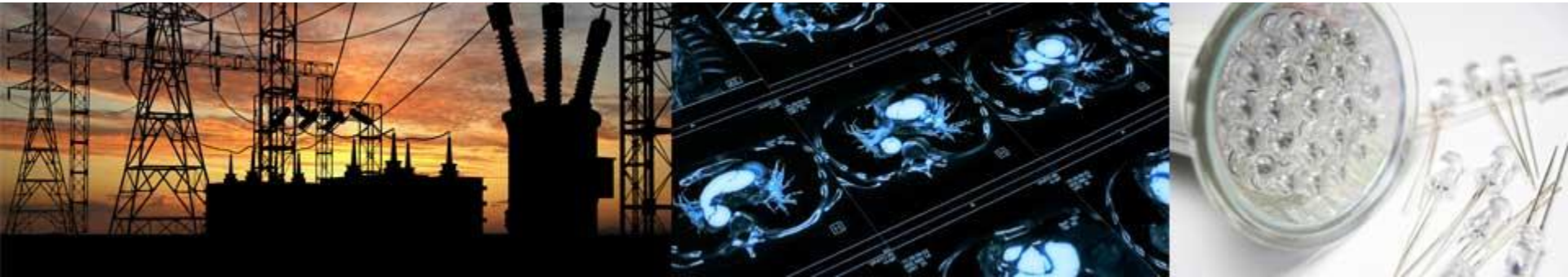
Attachment B
Stewart Presentation

EPA SF6 Emission Reduction Workshop

San Francisco, CA
January 24-25, 2017



The Association of Electrical and Medical Imaging Equipment Manufacturers





About Us

Electric Transmission & Distributions SF₆ Coalition

- Industry discussion of SF₆ related issues
- Industry voice for SF₆ policy and regulatory action
- OEMS, SF₆ producers and distributors, regulatory agencies and industry-related service companies
- Administered by NEMA
- <http://www.nema.org/Products/Pages/The-Electric-Transmission-and-Distribution-SF6-Coalition.aspx>

National Electrical Manufacturers Association

- Trade association and standards development organization
- Rosslyn, VA
- 350+ membership



The Association of Electrical and
Medical Imaging Equipment Manufacturers



SF₆ Reporting Challenges



SF₆ Emissions Reporting



US Greenhouse Gas Reporting Rule - Subpart DD

- Who? Owners and operators of electric T&D equipment >17,820 lbs
- What? Annual SF₆ emissions
- Where? US EPA, MA Dept of Env Protection and CA Air Resources Board
- How? Emissions = (Decrease in SF₆ Inventory) + (Acquisitions of SF₆) - (Disbursements of SF₆) - (Net Increase in the **Nameplate Capacity** of Equipment)
 - Inventory: The SF₆ stored in containers at the beginning of the year minus the SF₆ stored in containers at the end of the year.
 - Acquisitions: The sum of the amount of SF₆ that is: 1) purchased from distributors; 2) purchased from equipment manufacturers; and 3) returned to the facility after offsite recycling.
 - Disbursements: The sum of the amount of SF₆ that is: 1) in bulk and contained in equipment that is sold to other entities; 2) returned to suppliers; and 3) sent off site for recycling or destruction.
 - Nameplate Capacity: The nameplate capacity of new equipment minus the nameplate capacity of retiring equipment
- Emission Rate = lbs of SF₆ emitted/total **nameplate capacity** under management



Nameplate Background



Several points of information

- Make, model, insulation medium, voltage, etc.



Total Weight of Insulating Medium:

- Not a maximum threshold
- Meant to indicate approximate mass of SF₆ that GIE will hold once it is filled to the proper density



Nameplate Background



Where does SF₆ lbs figure come from?

- Nameplate figure = No safety indication
- Facilitates recordkeeping for purposes of inventory acquisition
- Temperature-pressure curve
 - PSIG @ Temp = Density
 - Volume (ft³) / Density = lbs.
- OEM calculations
- Industry standard - IEEE
 - OEMS
 - Utilities
 - No accuracy requirement



Reporting Challenges



Changes in Equipment Design

- Tank and bushing wall thickness = change in volume but not in required density for insulation
- Density = mass/volume
 - GIE Series A, Model 1: $0.38 \text{ lbs./ft}^3 = 526.3 \text{ lbs}/200 \text{ ft}^3$ (Nameplate says 526.3 lbs)
 - GIE Series A, Model 2: $0.38 \text{ lbs./ft}^3 = 513 \text{ lbs}/195 \text{ ft}^3$ (Nameplate says 526.3 lbs)
- If this GIE is involved in a **reportable event**, user would be forced to report a “phantom emission”
- Why didn’t OEMs change the nameplate?
- Resolution
 - Equipment in the field: OEM-User collaboration to change the nameplate
 - New equipment
 - IEEE Standards for nameplate accuracy
 - OEM internal initiatives (sealed equipment)



Reporting Challenges



Field Errors:

- Commissioning and Maintenance
 - Temperature-Pressure curve
 - Gas temperature, not ambient
 - Pressure gauge
 - Intentional overfill
- Decommissioning
 - Removal of SF₆ from tank to cylinder
 - Gas can remain trapped in the hose and/or recovery system (not emitted into the atmosphere)
 - Technician weighs cylinder and records missing SF₆ as an emission
 - Gas in the hose/recovery system ends up in another cylinder or GIE
- If this GIE is involved in a **reportable event**, user would be forced to report a “phantom emission” if amount of SF₆ is less than the nameplate.



Reportable Events

- 💡 Installed during the reporting year (NC of equipment operated)
- 💡 Retired during the reporting year (NC of equipment operated)
- 💡 Gas syphoned between GIE and storage cylinder (Inventory)
 - Emissions = (Decrease in SF₆ Inventory) + (Acquisitions of SF₆) - (Disbursements of SF₆) - (Net Increase in the Nameplate Capacity of Equipment)
- 💡 Gas syphoned from GIE into storage cylinder and sent off-site (Disbursement)
 - Emissions = (Decrease in SF₆ Inventory) + (Acquisitions of SF₆) - (Disbursements of SF₆) - (Net Increase in the Nameplate Capacity of Equipment)



Reportable Events

Gas syphoned between GIE and storage cylinder

Status January 1	Status December 31
GIE: Nameplate 100 lbs (charge 100 lbs)	GIE: Nameplate 100 lbs (charge 105 lbs)
Cylinder A: Empty	Cylinder A: 100 lbs
Cylinder B: 105 lbs	Cylinder B: Empty
Emission Calculation Formula: $(5) + (0) - (0) - (0) = 5$ lbs	



Prevalence of Error*

- 💡 Total HV circuit breakers inspected: **221**
- 💡 HV circuit breakers that had a nameplate discrepancy greater than 1%: **184**
- 💡 HV circuit breakers with inaccurate nameplates greater than 1%: **31**
- 💡 Tested within 1% accuracy: **6**
- 💡 Note: 1% error in nameplate capacity or discrepancy does NOT equal 1% error in emission rate

*Data provided by DILO



So What?

- 💡 No target for US EPA
- 💡 CA is currently at 4%; large enough margin to avoid fines
- 💡 BUT...
 - CA cutting targets to 1% by 2020, with fines
 - Who will follow?



Get Ahead of the Issue

 Reporting entities need the ability to correct reporting inaccuracies

- Accurately gage GIE charge
- Identify whether nameplate is accurate

 Methodology

- Pressure/Mass Calculation
- Complete SF₆ Recovery



Regulatory Solution



SF₆ Coalition working with regulatory agencies to allow...

- Use of figure other than nameplate; and/or
 - Would require collaboration with OEMs to certify the alternative figure
- **Statistical evidence of phantom emissions**



Regulatory agencies want/need to hear from the regulated community



The Association of Electrical and
Medical Imaging Equipment Manufacturers



Questions?

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Ms. Carey Bylin
September 22, 2020
Page 9

Attachment C
ABB Report of Findings on the SF6 Gas Amounts in
Westinghouse Type 2300SF Circuit Breaker



Report of Findings
On the SF₆ gas amounts in
Westinghouse Type 2300SF
Circuit breaker
For NRG
ABB Job# HOT10273

ABB, Inc.

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Executive Summary

ABB performed a detailed analysis of the original design drawings used by Westinghouse to manufacture the four 2300SF circuit breakers installed in the substation located at NRG's El Segundo generating plant. The purpose of this analysis was to determine the accurate amount of sulfur hexafluoride (SF₆) gas in the breaker versus the amount listed on the nameplate. The results of this study disclose a calculated amount of SF₆ gas in the subject Westinghouse 2300SF circuit breakers at 722 pounds compared to the original nameplate that lists 760 pounds.

Background

The Westinghouse 2300SF breaker is a two-pressure breaker. There are 2 separate but interconnected systems that use SF₆ gas. The first system is the low pressure system, which provides the line-to-ground insulation of the internal components of the breaker. The second system is the high pressure system, which provides a blast of gas across the opening contacts to extinguish the arc formed during fault interruption. The gas emitted from the high pressure system is vented to the low pressure system. A compressor replenishes the high pressure system by scavenging gas from the low pressure system.

Procedure

To determine the amount of SF₆ gas in the circuit breaker, it was decided to check two key parameters that were used in the original Westinghouse calculations; the density of SF₆ gas in the two systems, and the volume of the two systems in the circuit breaker. Densities of 1.61 #/ft³ for the low pressure system and 8.6 #/ft³ for the high pressure system are published in the instruction manual for this breaker. These numbers were verified. A comprehensive evaluation of the two systems was performed. In both systems, the volumes of the piping was determined to be negligible and was therefore ignored.

The volume of the high pressure system was calculated first. Components of the high pressure system are: the high pressure reservoir located under the breaker, the high pressure reservoirs on the end of the interrupters, and the insulated high-pressure feed tubes that connect these two reservoirs.

Next the low pressure system was calculated. Components of the low pressure system are the 3 phase tank assembly, the six bushings, three operating rods, three high-pressure feed tubes, and the three interrupters that each includes a high pressure reservoir. First the gross volume was found by calculating the volumes of the 3 phase tank assembly and the bushings. Next the volume of each of the internal components was approximated in turn. To find the net volume of the low pressure system, the volume of internal components was subtracted from the gross volume of the low pressure system. Finally, the two volumes were multiplied by the confirmed densities for each system, which resulted in the amount of SF₆ gas by weight in each system.

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Calculations

High Pressure System

120" phase spacing high pressure reservoir volume – 22.23ft³

Interrupter mounted high pressure reservoir volume – 1.51 ft³

Internal Feed tube volume - .12 ft³

Total volume of high pressure system = 22.23 + 3(1.51 + .12) = 27.12 ft³

Low Pressure System

Three phase tank assembly volume – 282.33ft³

Internal Bushing volume – 6.38ft³

Operating rod volume - .08ft³

High pressure feed tube external volume - .20ft³

Interrupter including high pressure external volume – 5.46ft³

Net volume of low pressure system – 282.33 + 6*6.38 – 3*(.08+.2 + 5.46) = 303.39ft³

SF₆ Gas Weight

HPS = 27.12*8.6 = 233.23 pounds

LPS = 303.39*1.61=488.46 pounds

Total SF₆ gas by weight = 233.23+488.46 = 721.69

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