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## Safeguard Guide for Recycling and Handling the Alternative of SF<sub>6</sub> GAS in Electrical Investigatory Applications

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### ABSTRACT

In recent Researchers most, important center of attention to abolish the need of SF<sub>6</sub> gas from insulation systems and develop a novel amalgamated surrogate gas with low GWP, premier insulating properties and cost effective. This new-fangled surrogate gas handling and recycling is a complex job. This forecast shall be probable after essential measurements and investigational work. So, it is urgent and imperative need of Safeguard outline for Handling and Recycling the substitute of SF<sub>6</sub> gas in electrical power equipment. This procedure establishes safe working practices list to perform elimination, supervision, and demolition of insecure by-products, normal and trouble maintenance work safely on SF<sub>6</sub> gas insulated apparatus.

**Keywords:** SF<sub>6</sub>, GWP, substitute, Safeguard, Guide, Recycling

## 1. INTRODUCTION

SF<sub>6</sub> is a popular choice and widely worn in electrical applications as an insulation medium application resembling the gas insulated transformers, Gas insulated power lines, non-flammable also match up to mineral oils which used as insulation particularly for the indoor environments it appropriate for a few particular uses in the electrical/electronic equipments, industrial processes, scientific fields and commercial products [1–3]. Unluckily SF<sub>6</sub> is a caustic greenhouse gas regulated by the Kyoto Protocol as 23,900 times extra dangerous than the CO<sub>2</sub>, which incorporate the environmental protection it is in the restricted list and theses destruction methods have aroused concerns about their toxicities in recent years [4-7]. Even though it is nontoxic but in case of leakage it is denser from air at a capability it can reconcile at the ground level substituting of oxygen in capacity which can reason on site produced suffocation and threat for human resources [8]. Due to this one it shifted the importance around the whole world to get better the efficiency of overall in power transmission and also for distribution system dependability and novelties should be unsafe for the environment [9]. Therefore, many countries are trying to employ substitute of SF<sub>6</sub>-insulated [10] so excellent solution is compulsory consequently for substitute insulation gas which has parallel or intimately analogous properties with Sulphur hexafluoride: By using a different classical breakdown experiments done the time- honored research has obtained theses surrogate gas mixtures of righteous gases with the SF<sub>6</sub>.

### 1. 1. Decomposition of Alternative Gaseous and consolidated By-Products

When exhibited to uninterrupted or profound electrical arcs, alternative gases like CO<sub>2</sub>, SF<sub>6</sub>:N<sub>2</sub>, CO<sub>2</sub>:CF<sub>3</sub>I:N<sub>2</sub> Air, SF<sub>6</sub>:N<sub>2</sub>, CF<sub>3</sub>I: Air, CF<sub>3</sub>I:N<sub>2</sub>, CF<sub>3</sub>I:CO<sub>2</sub> break down to cast metal-fluorides and sulfur-fluoride gases which are detrimental. Conceding that mist is under consideration, the disintegration by-products constitute sulfuric acids, sulfur-oxyfluorides and hydrofluoric. The existence of mentioned by-products can be promptly identified by gray or white powdery stuff also extremely aromatic odor like rotten eggs. Entire indulgence SF<sub>6</sub> and alternatives attachment shall be counterfeiting to encompass decay by-products. Each and every one workers should wear the shielding equipment described in this proceeding when abstract a gas, liquid and solid by-products.

**Table 1.** Gaseous SF<sub>6</sub> Decompositions Byproducts also emblematic Concentrations throughout recurring Sparking

Chemical Formula	Chemical Name	Chemical Abstracts Service Registry Number	Experimental Concentration (percent by volume)
HF	Hydrogen fluoride	7664-39-3	1.0
SOF <sub>2</sub> (SF <sub>4</sub> )	Thionyl sulfide (sulfur tetrafluoride )	7783-42-8 ( 7783-60-0)	0.5

SO <sub>2</sub> F <sub>2</sub>	Sulfur tetrafluoride oxide	13709-54-1	0.085
SiF <sub>4</sub>	Silicon tetrafluoride	7783-61-1	0.085
S <sub>2</sub> F <sub>10</sub> (SF <sub>5</sub> )	Di sulfur decafluoride	5714-22-7	0.025
SO <sub>2</sub> F <sub>2</sub>	Sulfury fluoride	2699-79-8	0.006
SO <sub>2</sub>	Sulfur dioxide	7446-09-5	0.002

OSHA policy on respiratory defensive equipment, 29 CFR 1910.134, feel necessity for that all workers wearing respiratory defensive equipment be well schooled in the treatment of these equipments. Decomposition by products of different gases given below Table 1.

## **2. HANDLING PROCEDURES AND CRITERIA**

CIGRE [11-14] has just presented a paper handling with SF<sub>6</sub> recycling, rework of SF<sub>6</sub> gas in electrical equipment and end discarding. Unfortunately, no considerable work has been done on alternative mixtures. It can be common declared that most of the phrasing, grouping, and safety proportions for manipulation the alternative of SF<sub>6</sub>. However, there are a few alternatives precise distinction that will be interpreted in the subsequent discussions. A CIGRE SF<sub>6</sub> Web site is currently under maturity which give Guidance on SF<sub>6</sub> recycling is given in references [15-18]

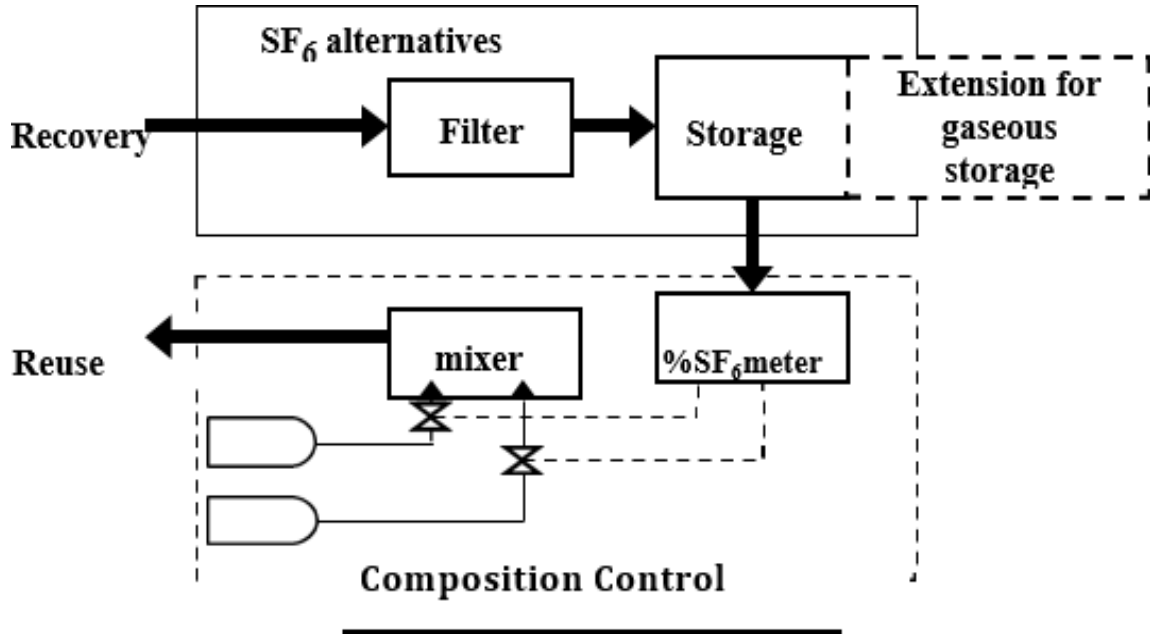
### **2. 1. Safety Practices to Handling SF<sub>6</sub> alternative Gas**

When Handling alternative gas-insulated apparatus Safety practices are mentioned below:

- Comply alternative gas treatment, reclaiming outdoors;
- If measures concern with alternative gas insulated equipment must be performed indoors, do work in a well- ventilated room; make sure the ventilating equipment is operating;
- No smoking;
- No unprotected boiler, flash, or arc-producing apparatus should be used in the area while the gas is being handled;
- If when manipulation of used alternative gas, the smell of rotten eggs is ascertaining, workers not wearing respiratory equipment should instantly depart that area;
- Be sure that any gas leaks at hose or stuffing connection at the breaker, on the supply cart, or at the cylinder is correct.

### 2. 1. 1. Preparation of mixtures of alternative gases

Available SF<sub>6</sub> alternative mixtures from gas suppliers in premixed form or as gas that's well again from equipment and purified by a reclaimed and tartan to be suited for reprocess. That gas can be precisely restored into equipment beyond appropriate cautions, as a gas is mixed, does not de-mix due to thermodynamic reasons.



**Figure 1.** Advancement of a predictable SF<sub>6</sub> alternative for the managing of SF<sub>6</sub> mixtures

Mixtures produced by mixing the component gases, appropriate cautions must be taken to certification complete mingling, especially while mixing is approved out when stodgy of electrical equipment. Equipment's with considerable volume a dynamic mixer is optimum suitable. It concurrently inserts the essential gases through turbulent jet-mixing zone; their fluxes are being guarded so that the best mixture symphony is obtained. A forceful mixer controlled by an SF<sub>6</sub> percentage meter may be used to precise the content of a mixture. For small volume of equipment's, the fundamentals of gases can be permeated into the Equipment "one after the others" accommodate sufficient time is permissible for their diffusive mixing before the equipment is establish for operation. Time of this diffusive mixing totally depends on the silhouette, shape, proportions and dimensions of enclosure that's quite lengthy procedure [19-20].

### 2. 2. Used Equipment's for handling alternative Decomposition Products

#### 2. 2. 1. Protective Gear

While handling alternative gas-insulated required minimum protective gear to be worn Apparatus are:

- Hooded disposable coveralls;
- Neoprene Gloves – 14inch which should be non-disposable.
- Robber Boots – 17 inches, over-the-shoe style also non-disposable;
- Supplied air-line respirator.

### **2. 2. 2. Storing Alternative Gas Cylinders**

Cylinders having alternative gas at a particular pressure can be run-down or ruptured by careless dealing.

Cylinders used for storing gas include requirements:

- Well-ventilated store cylinders area;
- Prevent the secured cylinders them from falling or being knocked over.

### **2. 2. 3. Heating an alternative Gas Cylinder**

If in cold ambient temperatures filling is performed, then cylinder may be heated any of the mentioned technique to change the liquid SF<sub>6</sub> in the cylinder to a gaseous state:

- An electric blanket heater;
- Immersing the cylinder of gas upright in a drum half filled with heated water so that bathe half of the cylinder is immersed. Water can be heated with a portable gas or electric heater.

## **3. WARNING**



**Figure 2.** Diaphragm compressors evacuates the alternative gas containment compartment an absolute pressure of 50MBAR and temperature.

Not ever heat a cylinder having gas in it with an exposed flame. Energies heaters and pressure rise only when displacing the gas. When treatment the cylinder, be confident that the thermal reading in the cylinder does not exceed 1000 F (380 °C). CF<sub>3</sub>I gas and other gases mixture as indicated by the SF<sub>6</sub> statistics shown in below Figure [21] as pressure raise, the voltage is predictable to increase with linearly as establish by supplementary researchers for SF<sub>6</sub> gas [22] When the field utilization factor is quicker to harmony. Research carried out by Katagiri et al. [23] shows that the interruption capability of these dissimilar gases mixture is to accomplish far superior gas mixtures [24]. Diaphragm compressors evacuates the alternative gas containment compartment an absolute pressure and temperature shown in below fig. Here, N<sub>2</sub> and CF<sub>4</sub> is better-quality to because it exhibits stronger dielectric synergy; i.e., an over-proportional influence of the SF<sub>6</sub> [25-26, 29-47].

### 3. 1. Removing alternative Gaseous Leftovers from Tools and Equipment

To clean tools and machinery that has been unprotected to alternative gas decomposed materials: The procedural features of an LCA have been standardized in the international ISO Standard 14040 [26]

Endow a mild (10%) lime or soda ash solution and use this as the negating solution the majority usually worn insulating gas in electrical systems to pass any test [27-28].

- Wash any hand used tools, non-removable protective gear, and equipment selected in the clean- up activity.
- Dispose a small quantity of this neutralizing solving through the hose and into the vacuum cleaner to nullify fragments adhering to this equipment.
- Dip all washed tools and equipment from top to bottom with water. Cleaning the rubber footwear and Neoprene gloves in water otherwise danger to health [28].

### 4. SAFETY CHECKLIST

Situations	Risks	Precautions	Body protections
Normal service (without handling gas)	NIL	NIL	NIL
Filling up unused gas	leakage of unused gas	Measure A	NIL
Maintenance operations (with handling used gas)	leakage of used gas	Measure B	<ul style="list-style-type: none"> <li>- Respirator</li> <li>- Overall</li> <li>- Gloves</li> <li>- Boots</li> <li>- Head protection</li> </ul>

Internal fault External fire	heavy leakage of polluted gas	Measure C	<ul style="list-style-type: none"> <li>- Respirator</li> <li>- Overall</li> <li>- Gloves</li> <li>- Boots</li> <li>- Head protection</li> </ul>
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Measure A:

Efficiently ventilate the room, do not operate alone.

Measure B:

Do not operate alone, Ensure availability of protective clothing and equipment in the vicinity. If acid odor occurs:

- warn the control engineer,
- ventilate the room,
- And if it is required to enter the room, wear protective clothing and equipment.

Measure C:

Warn firemen of the presence of SF<sub>6</sub>, warn the control engineer, Ventilate the room, and if it is required to enter the room, wear protective clothing and equipment SCOPE. The mentioned below branches are disturbed by this proceeding.

- Transmission & Distribution Sustaining
- Substation Development
- Generic Construction & Maintenance

## 5. CONCLUSIONS

This module lists procedures provide in a row without any danger to achieve installation, investigation, and sustainment work on gas-insulated stuff for alternative of Sulphur hexafluoride (SF<sub>6</sub>). In general, with plentiful other chemicals used every day in corporation, SF<sub>6</sub> gas and its substitute disintegration productions offers no damage or illness problems it dealt with well. As working with many other chemicals, health endangerment may happen under distinct circumstances, if exposure or handling is inaccurate or improper. All personnel nominated to perform supervision or maintenance work on SF<sub>6</sub>-insulated tools should refer to this module and must be followed.

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