

Impact of SF₆ Gas Emission on Global Warming & Methods of Reduction

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Abstract— In recent years, the environment has become a very important issue within society. Emissions of SF₆ gas from switchgear contribute significantly to the threat of the greenhouse effect and associated climate change. SF₆ gas is included in the Kyoto protocol for its contribution to the greenhouse effect. With the increase in the number of switchgear using SF₆ gas for switching and insulation purposes in electricity networks, emissions of SF₆ gas into the atmosphere will increase accordingly, a trend which will continue if policy remains unchanged. SF₆ traps 23,900 times more heat in Earth's atmosphere. Nevertheless, because its concentration is increasing at a rate of 8.7% /year and because its lifetime in the atmosphere is 3200 years, there is concern that its contribution to global warming could become significant in the future. Therefore, much research is now being conducted on finding a substitute gas for SF₆. We must find equivalent alternatives & make them commercially available on the market. We must also reduce SF₆ emission by leakage detection technologies like Infrared Thermography to reduce the impact on climate.

Key words: SF₆ Gas Emission, Global Warming, Leakage Detection, Infrared Thermography

I. INTRODUCTION

The rise in greenhouse gas (GHG) emissions from various industrial processes and activities has aroused international concern about the possible impacts of these emissions on climate. Greenhouse gases—mostly carbon dioxide, methane, ozone, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons, perfluorocarbons and chlorofluorocarbons and other trace gases—are emitted to the atmosphere, enhancing an effect in which heat reflected from the earth's surface is kept from escaping into space, as in a greenhouse. Thus, there is concern that the earth's surface temperature may rise enough to cause global climate change. An increase in global mean surface temperatures since the late 19th century - and recent data showing that the 20th century's 10 warmest years all occurred in the last 15 years - are an evidence of a dangerous trend. This Climate change is projected to result in changes to sea level, land and sea temperatures, cyclone intensity, frequency of fire weather, and frequency of extreme weather events including storms, drought and flood. In a nut shell it would have its impact on the surrounding environment including water, land, biodiversity and ecosystems, coastal zones, and the social environment [1].

India is a Party to the United Nations Framework Convention on Climate Change (UNFCCC) and the objective of the Convention is to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the

climate system. To strengthen the developed country commitments under the Convention, the Parties adopted Kyoto Protocol in 1997, which commits developed country Parties to return their emissions of greenhouse gases to an average of approximately 5.2% below 1990 levels over the period 2008-12.

Out of the six main groups of greenhouse gases, SF₆ is the most potent greenhouse gas. It is estimated that annual SF₆ gas production will reach around 8000 metric tonnes, 78 % of which is used in electrical energy technology for switching operations, cooling and insulation.

Gas	Atmospheric Life (Years)	GWP (100 Year Time Horizon)
CO ₂	-	1
CH ₄	12	21
HFC-134a	14.6	1300
CF ₄	50,000	6500
HFC-23	264	11700
SF₆	3,200	23900

Table 1: Various Green House gases & their Global warming Potential.

Source: Second Assessment Report (IPCC, 2007)

Emissions of SF₆ gas, particularly from the switchgear contributes significantly to the threat of the greenhouse effect and associated climate change. The United Nations institution that monitors this, the Intergovernmental Panel on Climate Change (IPCC), has since then added SF₆ gas to the list of extremely harmful greenhouse gases. The Kyoto Treaty (1992) stipulates that emissions of SF₆ gas must be reduced, though discouraging use is the best answer to this. Production of SF₆ is still increasing worldwide, despite the fact that this greenhouse gas is listed in the Kyoto protocol as "undesirable". Although there are now inspection, leakage prevention and recycling policies in place in most of the western countries, it is still doubtful if most of the used SF₆ will be prevented from escaping into the atmosphere [2].

II. SF₆ BASICS

A. Properties of SF₆

Sulphur hexafluoride (SF₆) is a man-made gas that is chemically inert, non-toxic, non-flammable, non-explosive and thermally stable at temperatures less than 500°C. SF₆ is colourless, odourless and With a gas density of 6.07 g/l (20 °C, 1 bar), SF₆ is about 5 times heavier than air and one of the heaviest known gases.. One of the main characteristics of SF₆ is its high chemical stability due to the six covalent bonds of its molecule. SF₆ is usually transported in the liquid form. The pressure required to liquefy SF₆ at 21°C is about 2,100kPa and it is therefore normally liquefied by compression.